The Importance of Neighborhood when Predicting Airbnb Prices

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Data Science Major Capstone

WELLESLEY

Research Question

How strongly does the neighborhood impact or correlate with Airbnb prices in Boston, San Francisco, and Washington D.C.?

Background

Exploring Airbnb prices is a great way to understand equity issues within the current market for rental spaces. Airbnb can contribute to local renting markets through investment into homes and the neighborhood (Xu, 2021). Unfortunately, in the long-term the over-tourism that companies like Airbnb facilitate can push out residents, in a process similar to gentrification (Bivens, 2019). Furthermore, research has shown that Airbnb can contribute to neighborhood gentrification and a widening of the rent gap (Wachsmuth 2018). The goal of this research is to highlight the differences in pricing for Airbnb apartments based on neighborhood, which may highlight gaps in opportunity or have consequences for the way that urban planners interact with Airbnb.

Data

Data for this project was pulled from Inside Airbnb's dataset of Airbnb listings from October 2020. This project focuses specifically on apartment listings in Boston, Washington D.C., and San Francisco. The figure below highlights potential equity issues around race by graphing Airbnb rental prices against the racial proportions of neighborhoods in Boston. It's just one example – similar graphs could be made for D.C. or San Francisco.

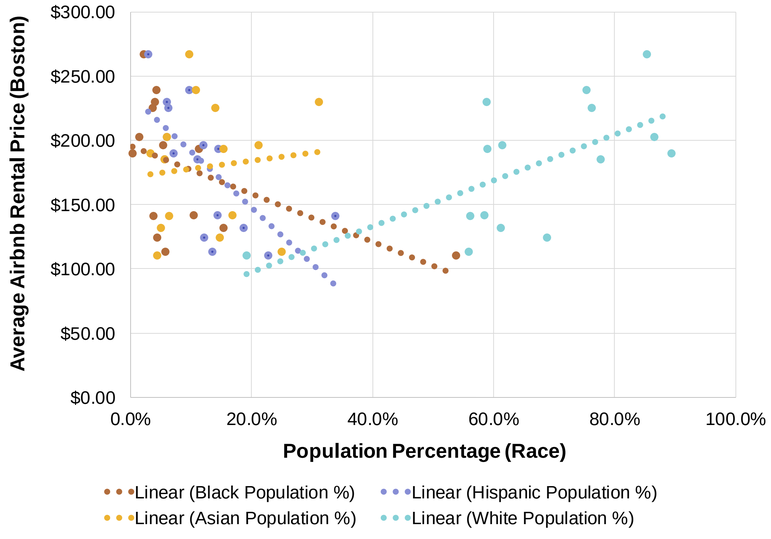

Fig 1. Average Boston Neighborhood Airbnb Price by Racial Population Race Percentages. Data from Airbnb and ACS.

Average Airbnb Price per Night by Neighborhood

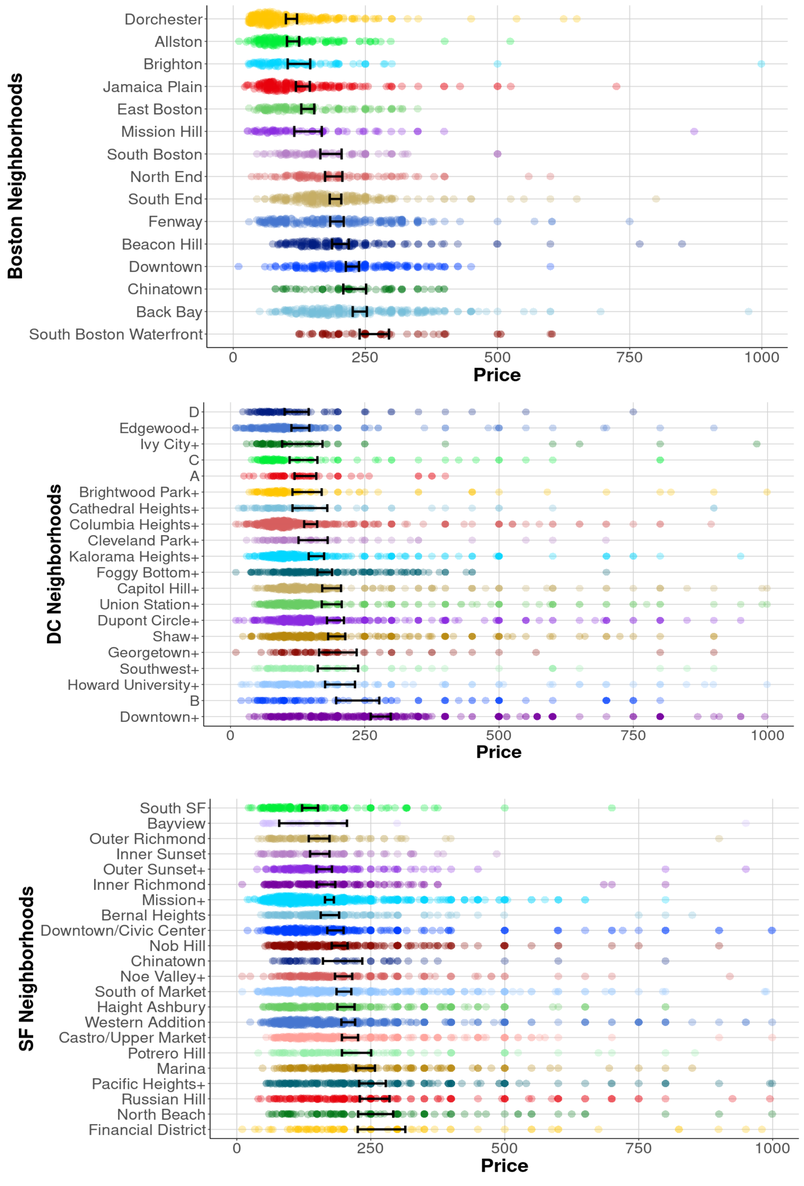

Fig 2. Forest Plots of Airbnb Prices by Neighborhood, least to greatest, for Boston, Washington D.C. and San Francisco in that order. Error bars show 95% confidence interval. Data from Airbnb.

Comparing Models with and Without Neighborhood

Linear regression models that initially included listing characteristics (Cancellation Policy (SD 0.054), Review Scores Cleanliness (0.049), Room Type (0.036), Bathrooms (0.015), Guests (0.011), Beds (0.006), Number of Reviews (0.004), Review Scores Communication (0.004), Minimum Nights (0.003)) were more predictive of Airbnb price when neighborhood was included in the model.

City	Adj. R^2 With Neighborhood	Adj. R^2 Without Neighborhood
Boston	0.6634	0.5669
Washington D.C.	0.3723	0.3052
San Francisco	0.487	0.4381

Table 3. Table comparing adjusted R^2 with neighborhood as a model variable to adjusted R^2 without neighborhood in the model for each city. Data f--rom Airbnb.

Methods

I first consolidated neighborhoods into levels based on socioeconomic characteristics, then used multiple imputation to deal with missingness. The initial linear regression models were produced by applying AIC and BIC to determine the best single-order models. Then, of the models identified, I chose the most useful using 5-fold cross-validation. Finally, I checked regression assumptions, applied a Box-Cox transformation to the price variable, and removed influential outliers.

Data Ethics and Limitations

The main ethical issue with this data is that some neighborhoods had to be consolidated into levels with other neighborhoods during the data cleaning process, due to low levels of Airbnb rentals in those neighborhoods. While socioeconomic characteristics were the main method for finding appropriate groupings, consolidation necessarily may include the obfuscation of demographic trends. A major limitation is that this data did not include socioeconomic characteristics by neighborhood, which is thus an opportunity for expansion in future research.

Sources

Bivens, Josh. (2019). The economic costs and benefits of Airbnb: No reason for local policymakers to let Airbnb bypass tax or regulatory obligations. Economic Policy Institute, https://www.epi.org/publication/the-economic-costs-and-benefits-of-airbnb-no-reason-for-local-policymakers-to-let-airbnb-bypass-tax-or-regulatory-obligations/

Wachsmuth, D., & Weisler, A. (2018). Airbnb and the rent gap: Gentrification through the sharing economy. Environment and Planning A: Economy and Space, 50(6), 1147–1170. https://doi.org/10.1177/0308518X18778038

Xu, Minhong & Xu, Yilan. (2021). What happens when Airbnb comes to the neighborhood: The impact of home-sharing on neighborhood investment. Regional Science and Urban Economics, 88. https://doi.org/10.1016/j.regsciurbeco.2021.103670