DC Tree Canopy Analysis

Sta199 Project

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Research Question

- In Washington, D.C., how do income and ownership type influence tree density? How strong of a predictor are these variables compared to other factors, namely possible planting area and non-canopy vegetation?
- We hypothesize that higher income areas will have higher tree density
    - Residents in these areas could have more disposable income for planting and landscaping.
- We also think that tree density would be higher with more owner-occupied housing
    - Owner-occupied homes have full agency over the land and may have yards with more room for plants as opposed to rented housing.

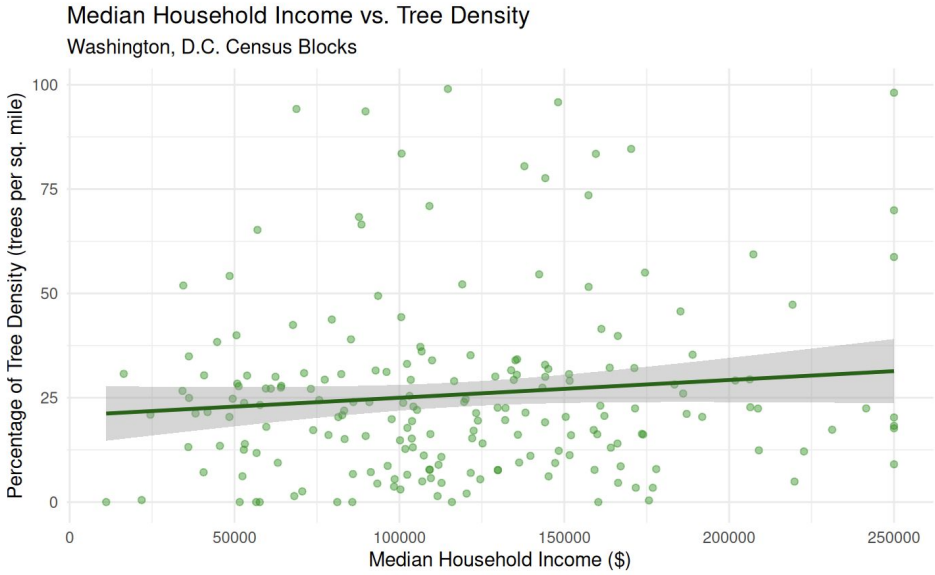
Hypothesis and motivation

- We hypothesize that areas with greater possible planting area and vegetation will have higher tree density
- We also think that these variables are stronger predictors of tree density compared to income and housing
    - Directly tied to the possibility of tree growth
- Why this research question? Our motivation:
    - Examines inequality from an environmental perspective, and it can potentially inform officials of where they should be focusing environmental efforts.

Our data

- All data obtained from Open Data DC, the official open data portal for the District of Columbia government.
- **Urban Tree Canopy by Census Block in 2020** — assesses urban tree canopy distribution per Census Block
  - Important metrics: Urban Tree Canopy (UTC), Possible Planting Area in Acres (PPA), and Vegetation (VEG)
- **ACS 5-Year Economic Characteristics** — assesses economic characteristics per Census Block
  - Important metrics: Median household income
- **ACS 5-Year Housing Characteristics** — displays housing characteristics per Census Block
  - Important metrics: Number of owner-occupied homes, number of renter-occupied homes, total homes

Tree Equity Gap in DC

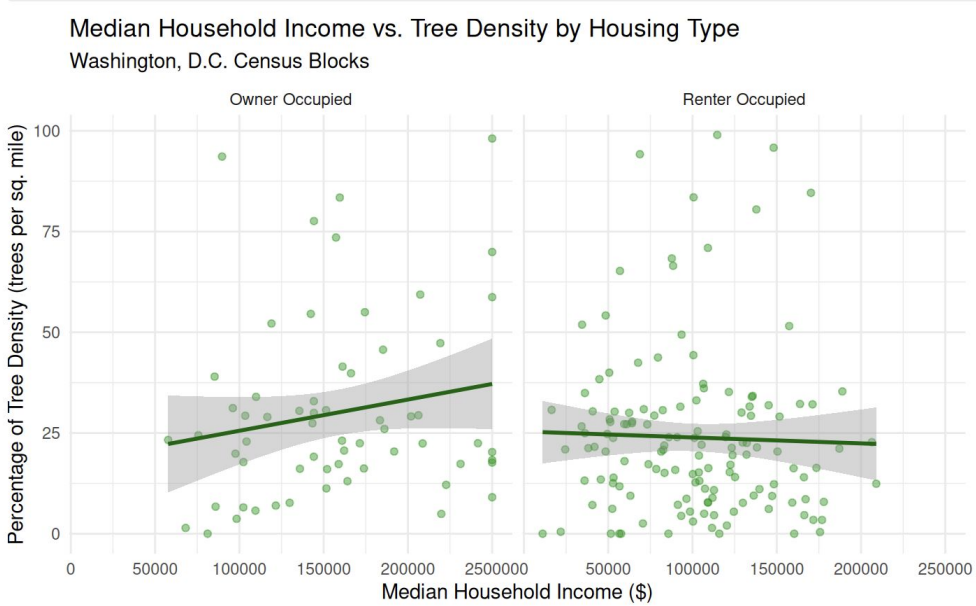


Conclusions:

- Weak positive trend
  - higher median household income slightly indicates a higher percentage of tree density
- Outliers across all income types (data highly varied)
- 1% more tree canopy in DC is around 0.68 sq miles

Income Level	Mean UTC%
Low Income	24.17444
Middle Income	25.61547
High Income	26.98750

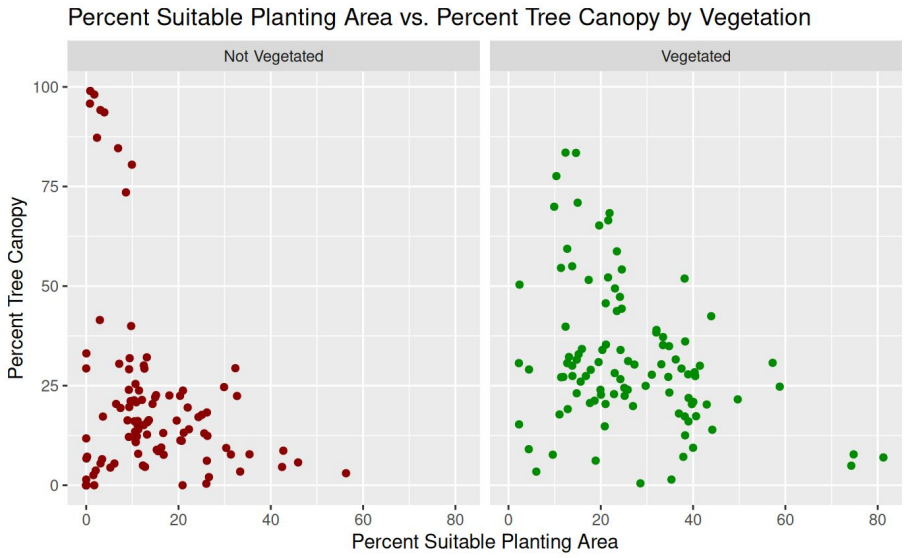
Owner vs. Renter Occupied Housing



Conclusions:

- Positive correlation between median household income and percentage of tree density for owner occupied housing
- Minimal correlation between median household income and percentage of tree density for renter occupied housing
- Matches our hypothesis that owner–occupied homes have full agency over the land and promotes higher percentage of tree density whereas the percentage of tree density does not increase even as median household income increase in renter occupied homes

Suitable Planting Area and Vegetation



Conclusions:

- Vegetation has little effect on percent tree canopy
- Strong negative correlation: Higher percent of suitable planting area tends to have a lower percent tree canopy
    - In cities, land that is ‘suitable’ is often used for recreation, utility access, development, etc.

Comparing Predictors

Income–Housing Model

r.squared <dbl>	adj.r.squared <dbl>	sigma <dbl>	statistic <dbl>	p.value <dbl>	df <dbl>	logLik <dbl>
0.02072012	0.0108284	21.03861	2.094694	0.1258277	2	-896.0136

Planting Area–Vegetation Model

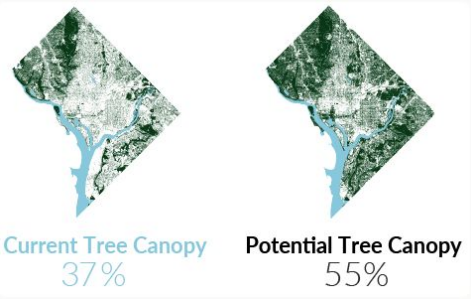
r.squared <dbl>	adj.r.squared <dbl>	sigma <dbl>	statistic <dbl>	p.value <dbl>	df <dbl>	logLik <dbl>
0.07797529	0.06880091	20.74746	8.499248	0.0002861...	2	-906.5668

- **Conclusions:** Income and housing is a weaker predictor compared to Suitable Planting Area and Vegetation
  - Income–Housing R: 0.14
  - Planting Area–Vegetation R: −0.28

DC Tree Planting Initiatives

- 90’s DC went through a 16% loss of UTC
- Nonprofits such as Casey Trees formed to restore and protect canopies
- Sustainable DC launched in 2011 with a 40% UTC goal by 2032
- Efforts list current UTC at 37% but census data calculated 26%
- Disparities in tree maturity
- Census block variability

Casey Trees®
WASHINGTON DC

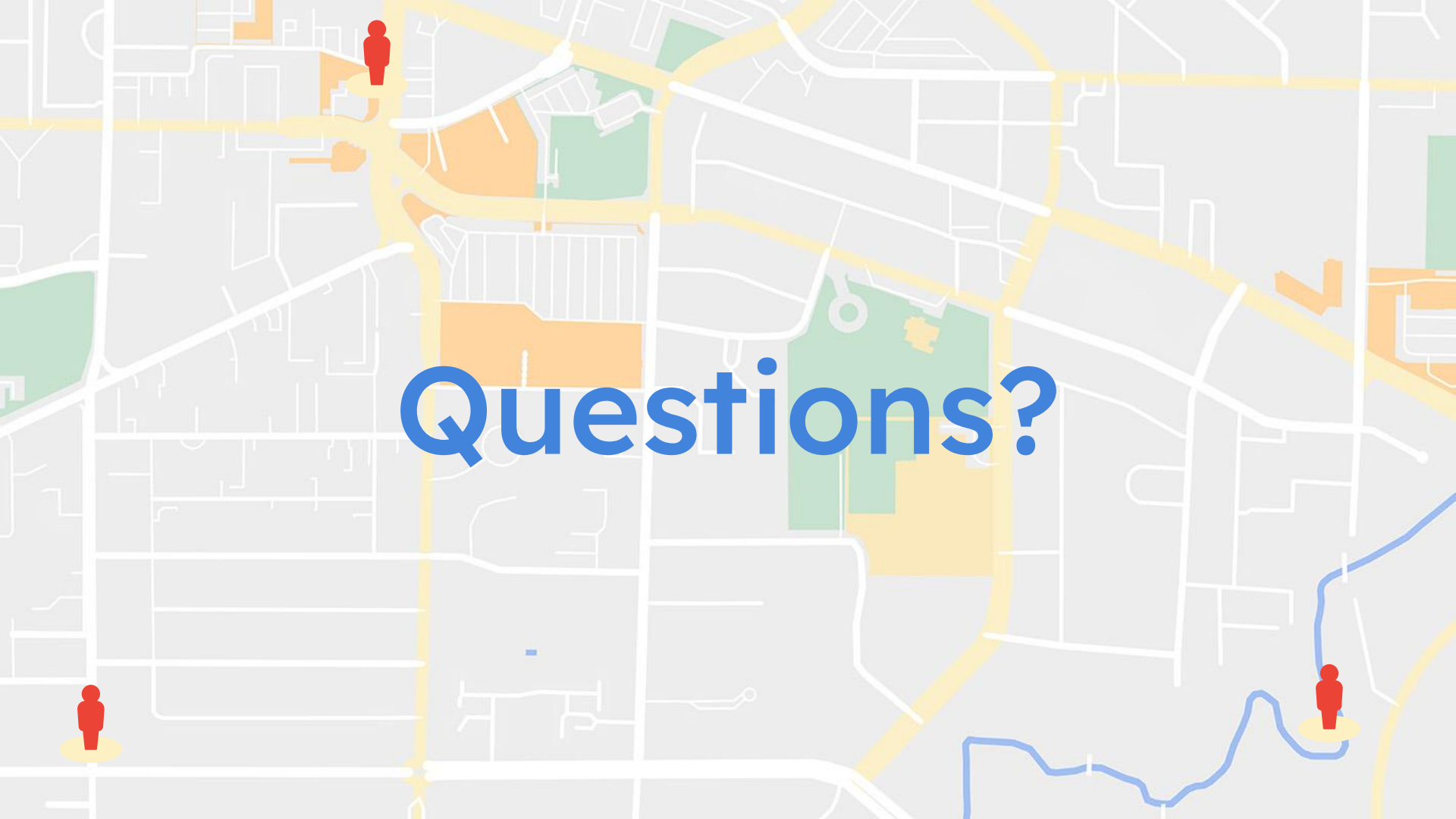


Total UTC%
26.21647

Census block	Median Income	UTC%	Income Level
004704	11094	0.00	Low Income
009801	16415	30.73	Low Income
007403	21850	0.48	Low Income
001500	250001	98.09	High Income
002002	250001	17.67	High Income
002600	250001	69.92	High Income

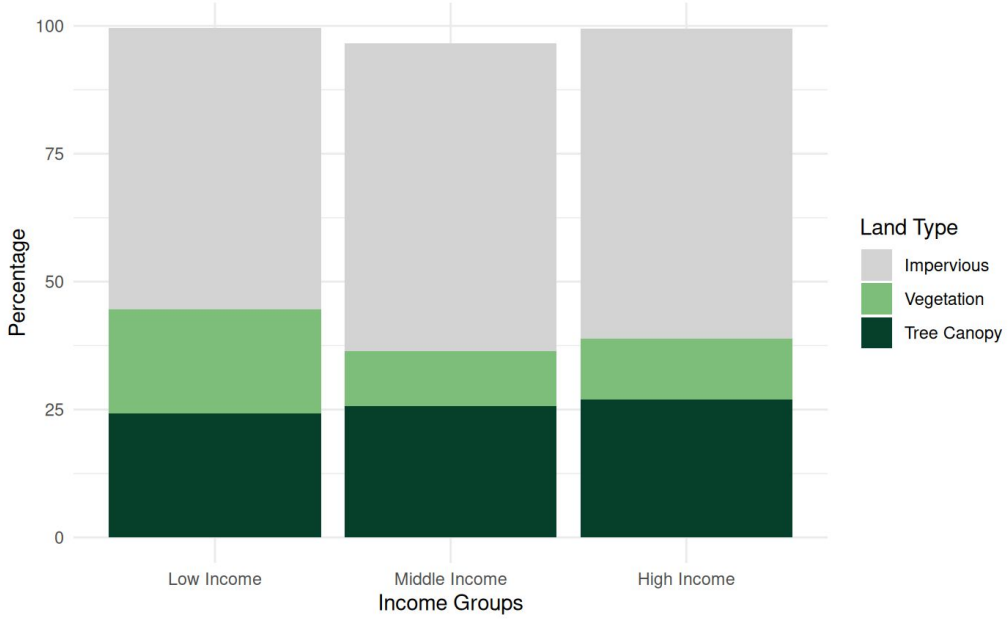
Conclusions, Discussion & Critique

- **Main Finding 1:** The correlation between median household income, tree canopy density, and ownership type was weaker than hypothesized. DC's canopy distribution appears relatively equitable across income groups
  - **Possible Explanation:** Wealthier areas have mature trees. Though DC's forestry initiatives are actively counteracting inequity, disparities still exist.
- **Main Finding 2:** Housing type and income are a weaker predictor for Tree Density compared to factors like Suitable Planting Area and Vegetation, as expected
- **Critiques:**
  - Some census blocks have very small areas (some were less than 1 acre)
  - Parks and business were included in the census blocks and possibly throw off the data


Questions?

Appendix

Green Area by Income Group



Conclusions:

- Low income blocks have the most vegetation but least canopy.
- Vegetation takes up the most land area with in census block with low income
- Wealthier areas have higher UTC percentage but also more mature trees
- Impervious surfaces take up most of the land area across census blocks
- Tree canopy is relatively similar across income groups