Executive Summary

Business Goal

The business goal is to determine optimal locations for a startup craft brewery within the Denver Metro area, considering factors such as low competition from existing breweries and a population capable of sustaining regular customers.

Approach

1. Data Collection

- Population densities and demographics were analyzed using the latest US Census Bureau data.

- The Foursquare API, Google, and coloradobrewerylist.com were used to identify established craft breweries in the region.

2. Hypothesis

- Craft beer consumption in the Denver-Lakewood-Aurora Metropolitan Statistical Area is influenced by demographic factors, including existing breweries, education, household income, age distribution, gender composition, ethnic diversity, and specific occupational profiles.

3. Geographic Boundaries

- US Census Bureau shapefiles for the Denver Metro area were used to define geographic boundaries.

- Focus on the Denver-Lakewood-Aurora MSA and adjacent areas, excluding Boulder.

4-7. Analysis Methods

- Geospatial Analysis: Utilized Geopandas for spatial joins and consolidated geometry.

- Demographic Analysis: Employed American Community Survey (ACS) 2021 data for Census Place-level analysis.

- Craft Beer Drinker Demographics: Considered key demographics based on craft beer trade associations publications.

- Occupational Analysis: Evaluated occupations with higher alcohol consumption rates.

8. Conclusion

- Synthesized findings to recommend optimal locations for the craft brewery based on the desired demographic profile and minimal competition from existing breweries.

Brewery Data Collection

- Breweries were sourced from FourSquare, Google, and coloradobrewerylist.com within the Denver-Lakewood-Aurora Metropolitan Statistical Area (MSA).

- Coloradobrewerylist.com was identified as the most accurate and comprehensive source for brewery information in the region.

Brewery Comparison

- Google's Places API includes non-brewery establishments.

- Foursquare lacks a significant number of breweries within the Denver MSA.

- Coloradobrewerylist.com provides a comprehensive list, excluding some chain establishment locations.

Geospatial Demographic Analysis

- Choropleth plots using the Folium library were created to analyze demographics.

- Median household income was identified as an important factor.

- Covariance and multicollinearity were considered.

Variables Exploration

- Examination of mean and median household income revealed outliers and potential wealth disparities.
- Population density varied, with larger cities having lower densities.
- PCA was used for dimensionality reduction and understanding relationships within the data.

PCA Overview

- Two DataFrame orientations were considered: Places and Variables.
- Scree plot and PC1 vs PC2 plots provided insights into data variation.
- PC1 loadings identified influential features contributing to data patterns.

Census Places - K-Means Clustering

- KMeans clustering with a silhouette score of 0.76 suggested 4 optimal clusters.
- Denver and Aurora formed distinct clusters, while Lakewood did not.
- Clusters were stratified by total population.

Census Places - Agglomerative Clustering

- Agglomerative clustering with five clusters identified natural density structures.
- Denver, Aurora, and Lakewood naturally formed their own clusters.

Census Places - DBSCAN Clustering

- DBSCAN with 'euclidean' metric and a silhouette score of 0.70 identified 5 optimal clusters.
- Clustering aligned with agglomerative clustering, providing insights into brewery distribution.

Brewery Locations - DBSCAN Clustering

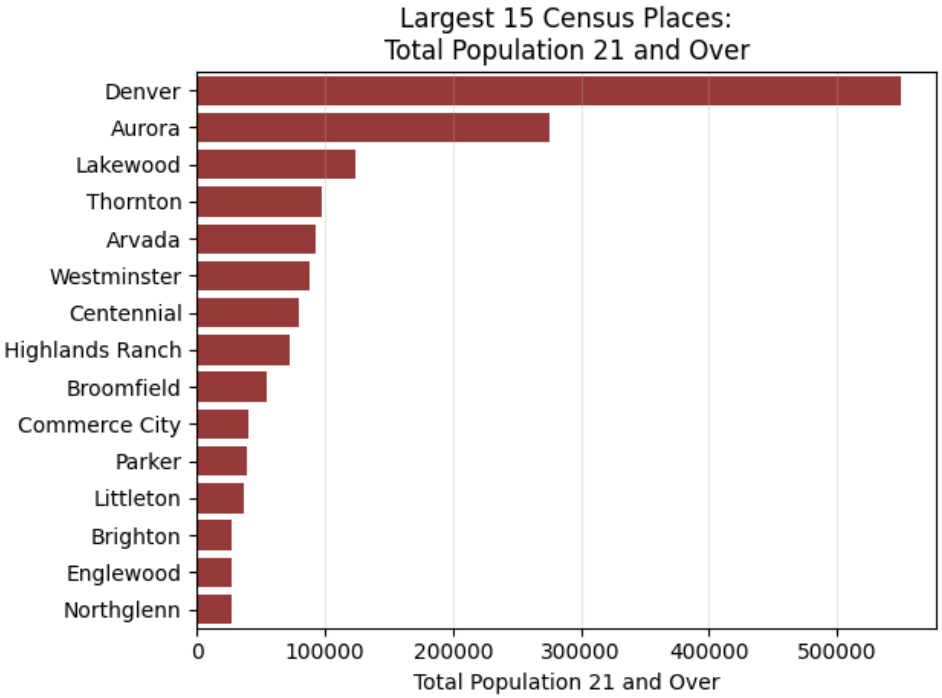
- DBSCAN with 'haversine' metric identified 31 optimal clusters for 181 breweries.
- Despite a low silhouette score, geospatial plots revealed distinct brewery clusters.
- Notable clusters included the central urban core encompassing downtown Denver, Denver International Airport, Aurora, Golden and various suburban areas.

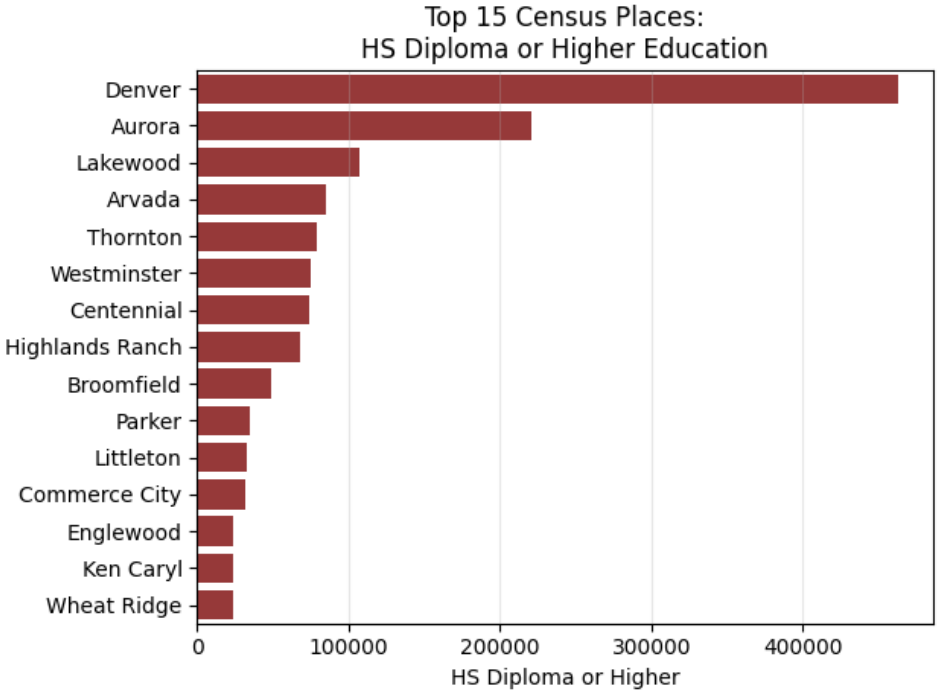
Conclusions

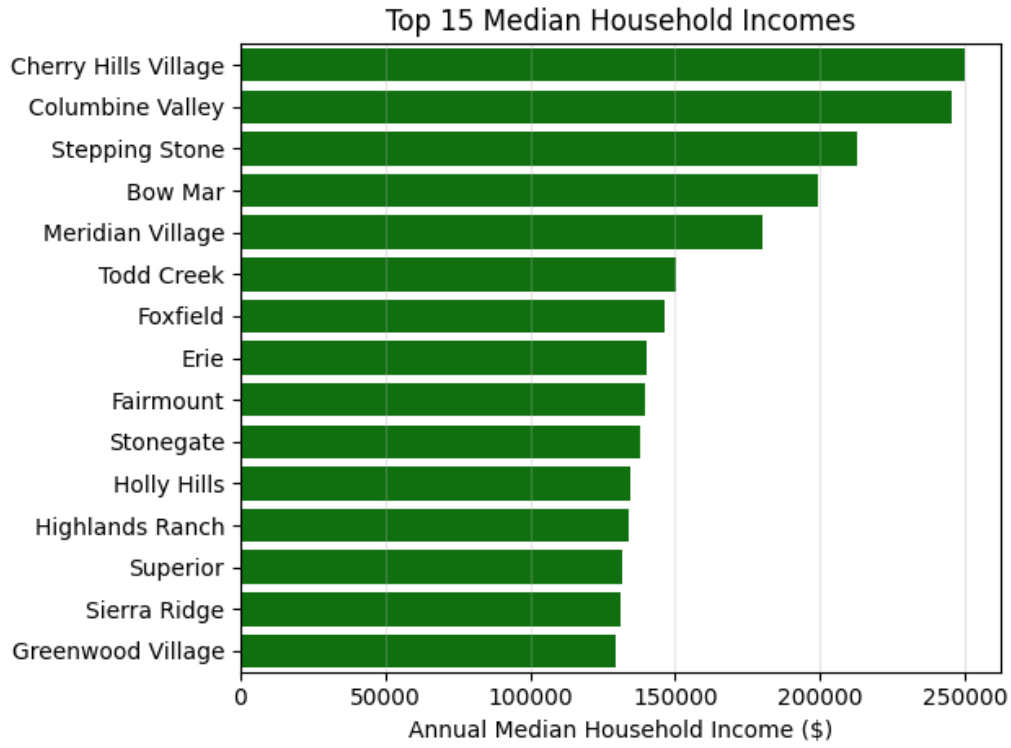
- Unexpectedly, total population emerged as a comprehensive determinant of demographic clustering.
- Clustering algorithms confirmed the interdependence of demographic variables on total population.
- Multiple clustering methods provided a comprehensive understanding of the data's structure.
- Denver, Aurora, and Lakewood consistently stood out, reflecting their unique characteristics.
- A higher density of breweries are found in downtown Denver, Arvada, Centennial, Highlands Ranch and Golden.
- There are a lower concentration of breweries in Thornton, Lakewood, and Westminster but greater populations capable of supporting craft brewery patronage
- Summaries found within Jupter Notebooks emphasize the role of population in understanding the Denver Metro area's brewery distribution.

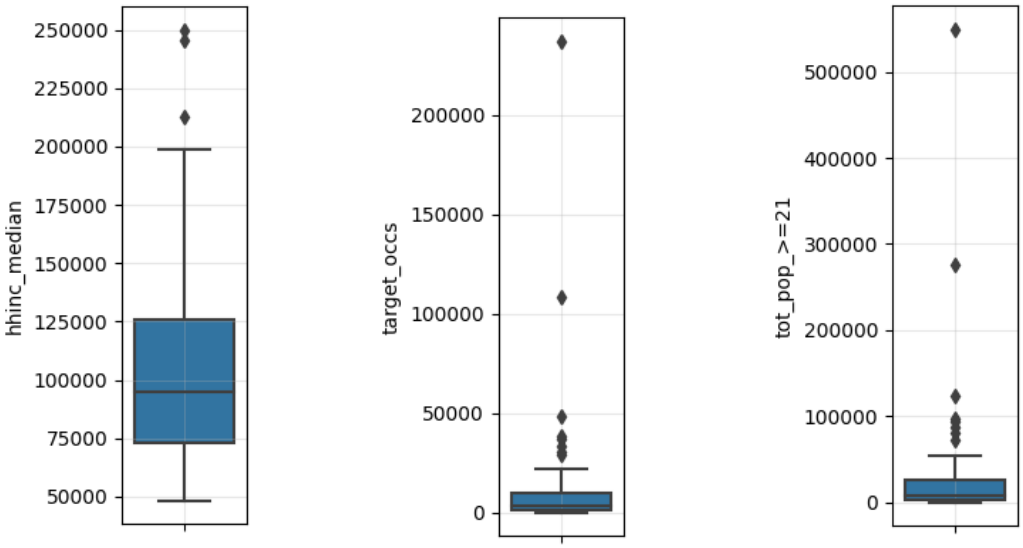
Figures

Exploratory Data Analysis

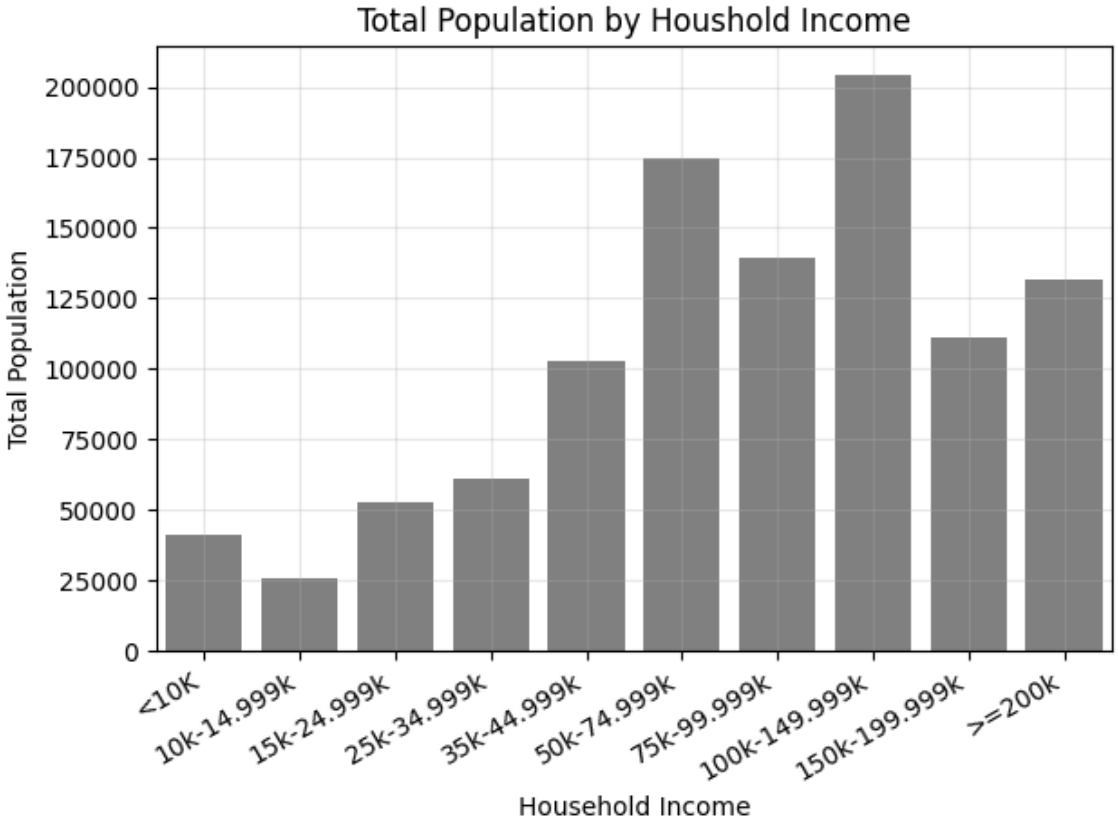


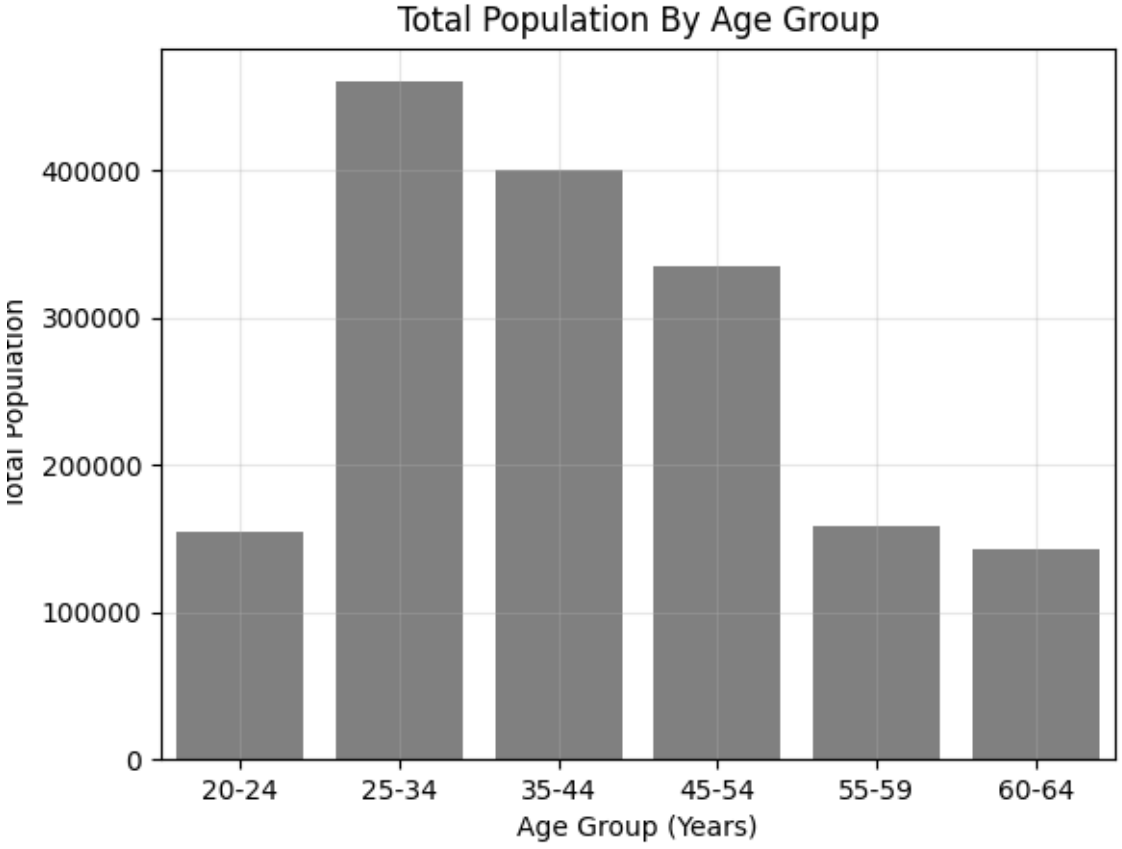


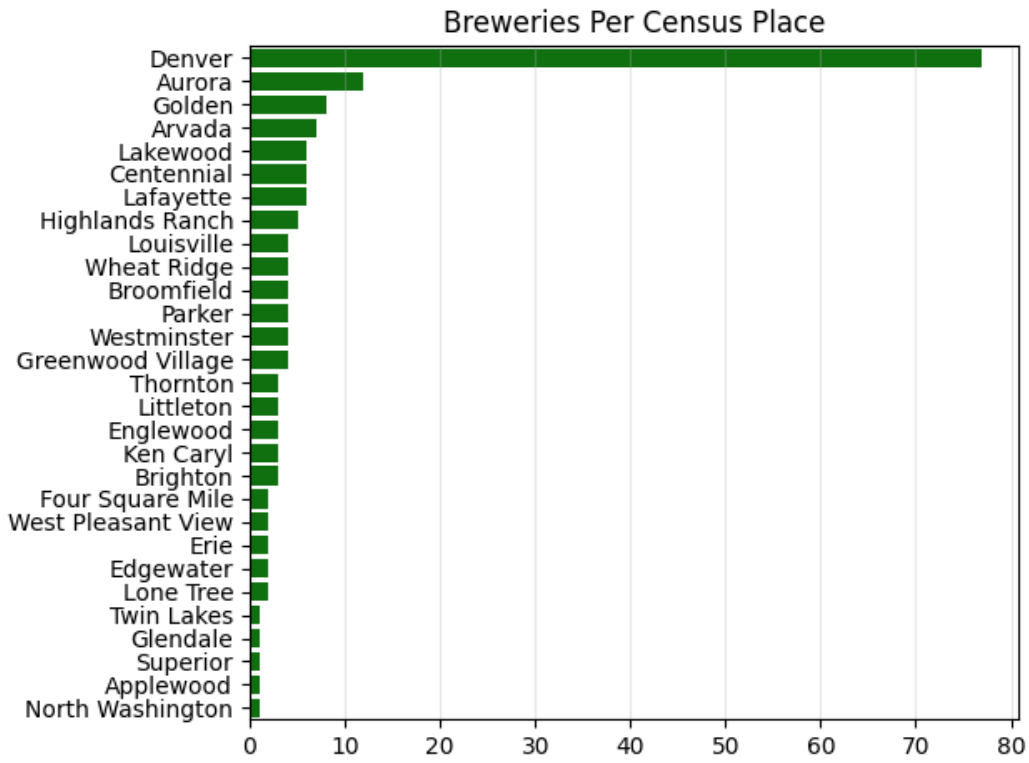


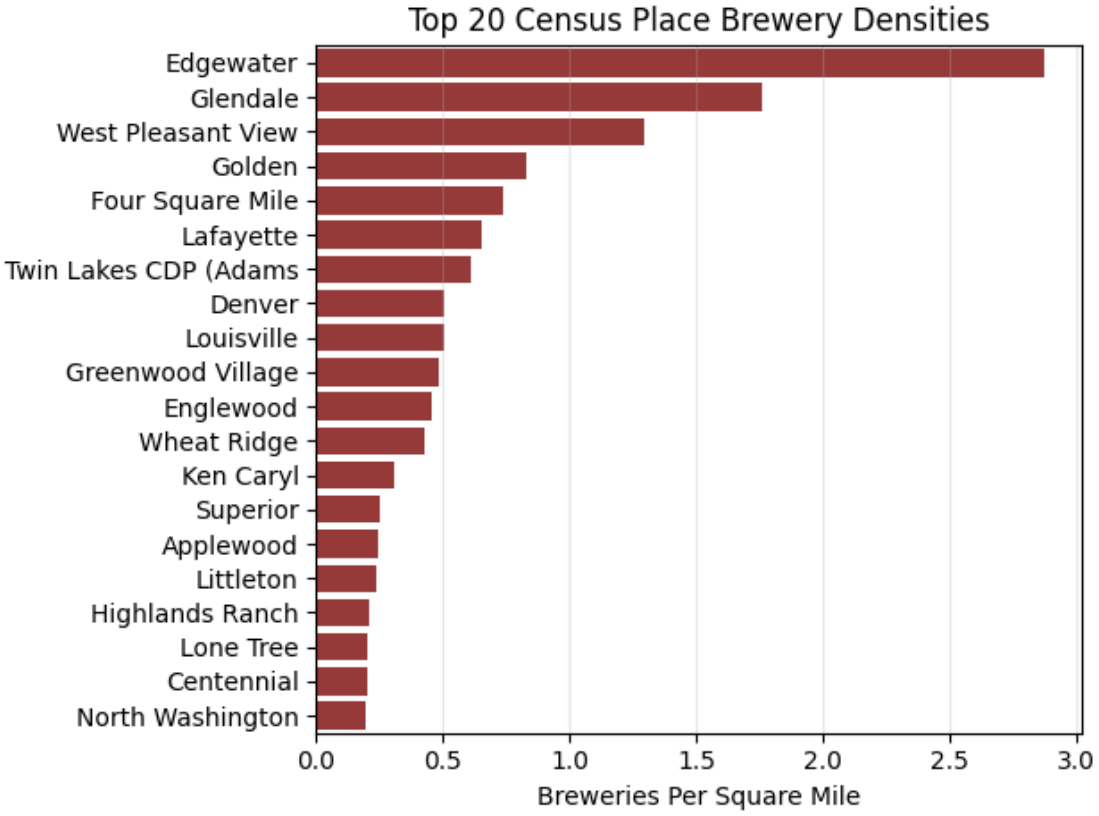


Target Occupations: target_occs


Total Population by Houshold Income
Total Population
200000
175000
150000
125000
100000
75000
50000
25000
0
<10K
10k-14.999k
15k-24.999k
25k-34.999k
35k-44.999k
50k-74.999k
75k-99.999k
100k-149.999k
150k-199.999k
>=200k
Household Income

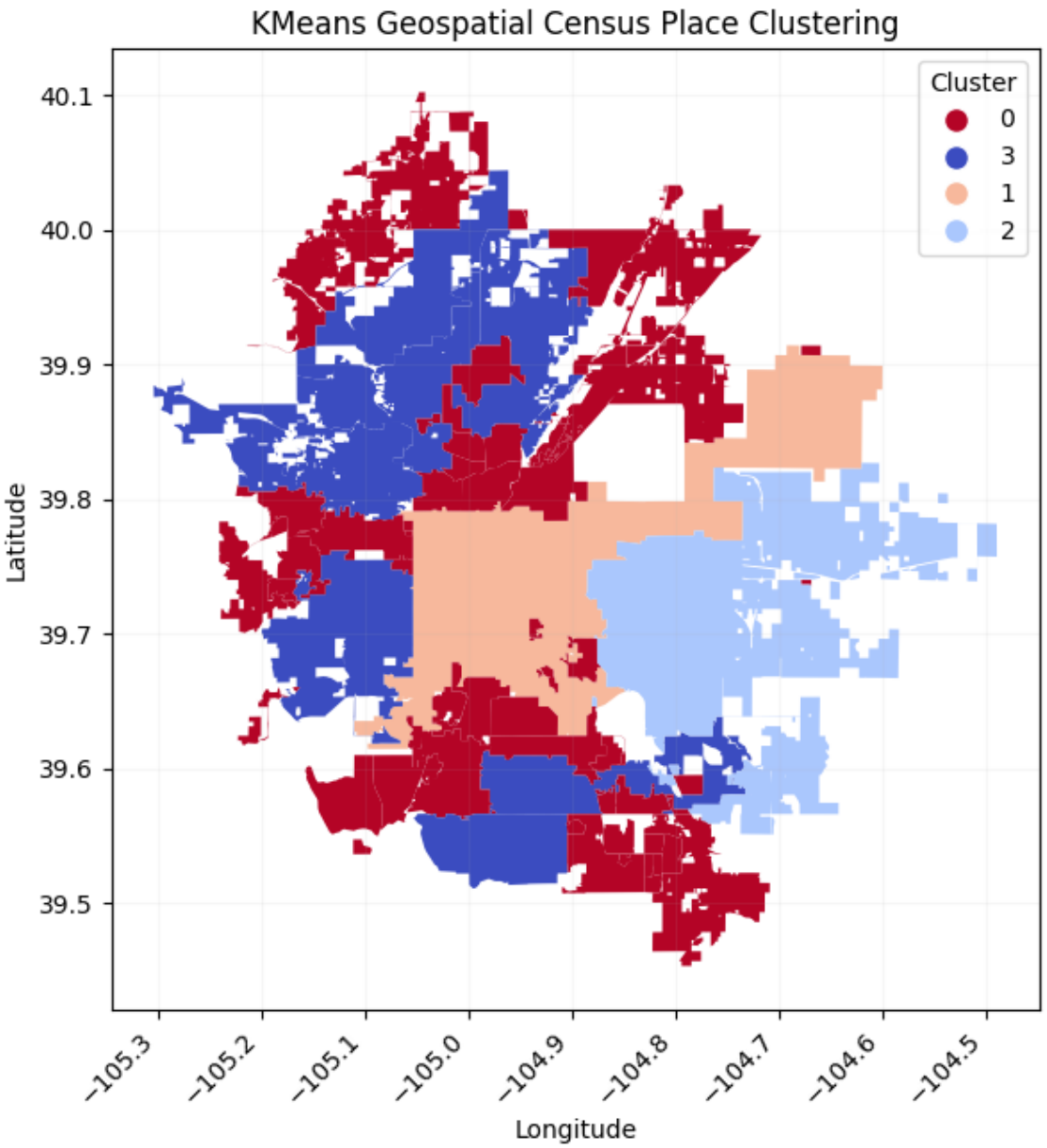

Total Population By Age Group
400000
300000
200000
100000
0
20-24
25-34
35-44
45-54
55-59
60-64
Age Group (Years)


Breweries Per Census Place
Denver
Aurora
Golden
Arvada
Lakewood
Centennial
Lafayette
Highlands Ranch
Louisville
Wheat Ridge
Broomfield
Parker
Westminster
Greenwood Village
Thornton
Littleton
Englewood
Ken Caryl
Brighton
Four Square Mile
West Pleasant View
Erie
Edgewater
Lone Tree
Twin Lakes
Glendale
Superior
Applewood
North Washington
0
10
20
30
40
50
60
70
80

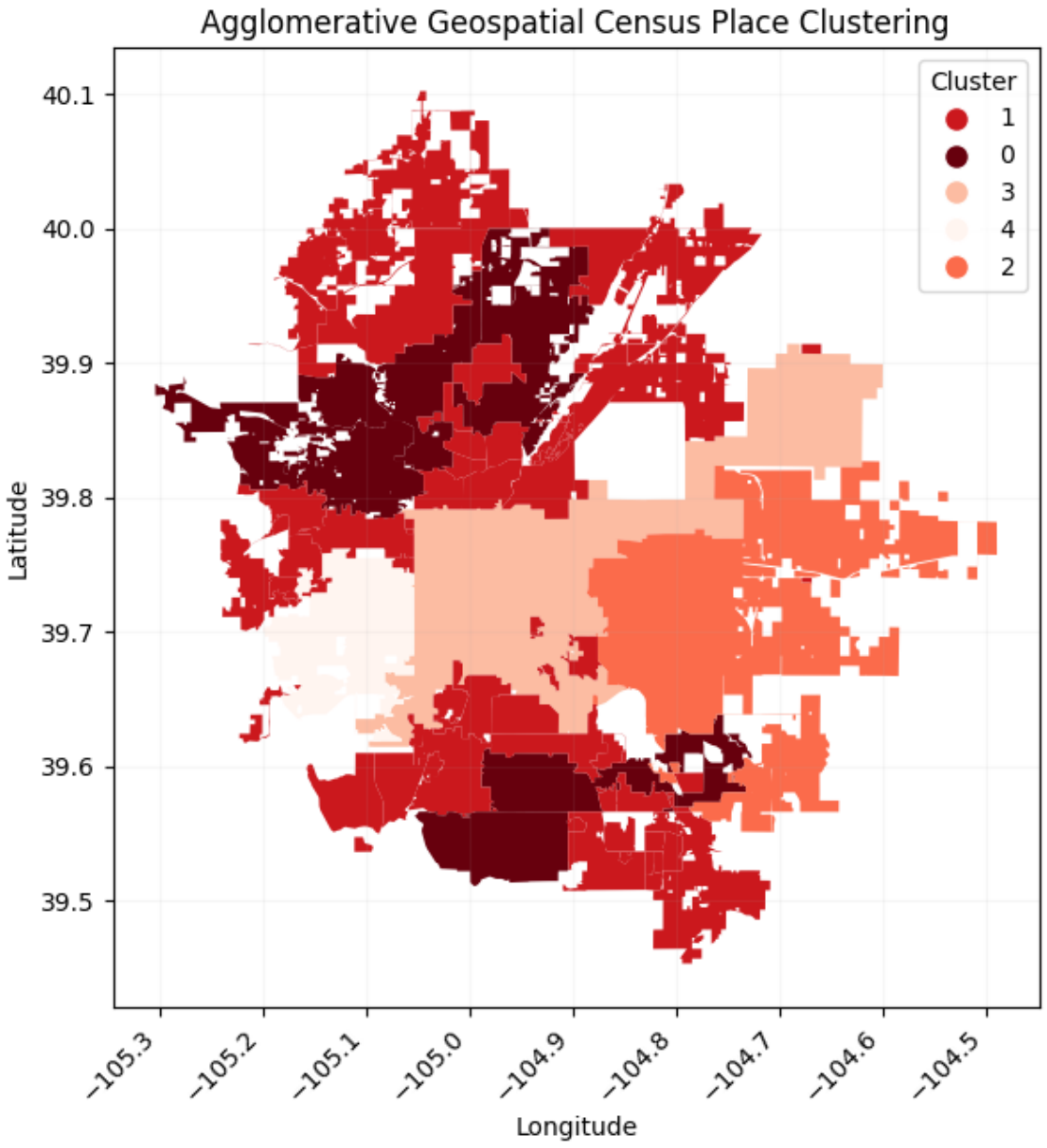

Top 20 Census Place Brewery Densities
Edgewater
Glendale
West Pleasant View
Golden
Four Square Mile
Lafayette
Twin Lakes CDP (Adams
Denver
Louisville
Greenwood Village
Englewood
Wheat Ridge
Ken Caryl
Superior
Applewood
Littleton
Highlands Ranch
Lone Tree
Centennial
North Washington
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Breweries Per Square Mile

Models

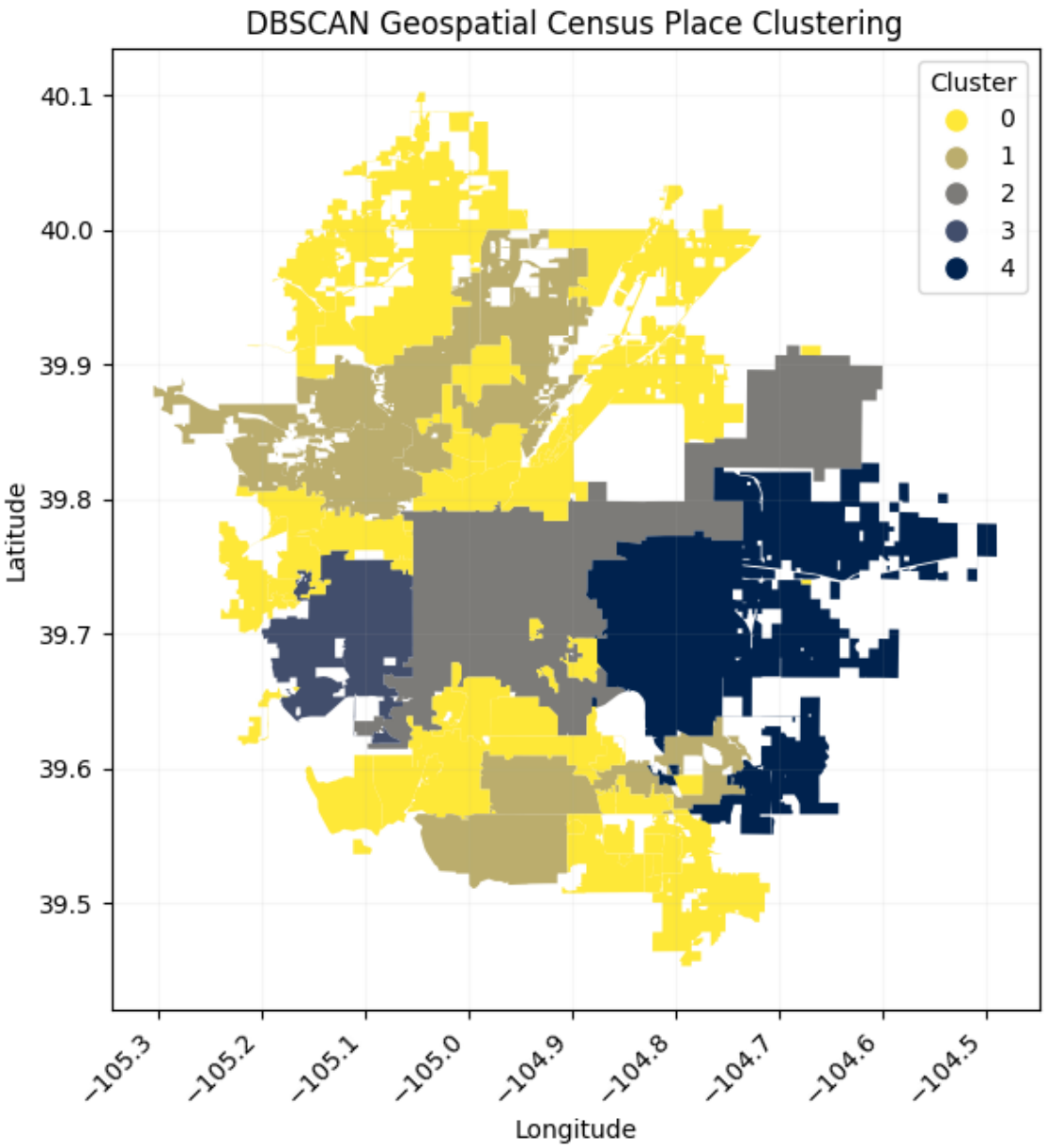
Kmeans



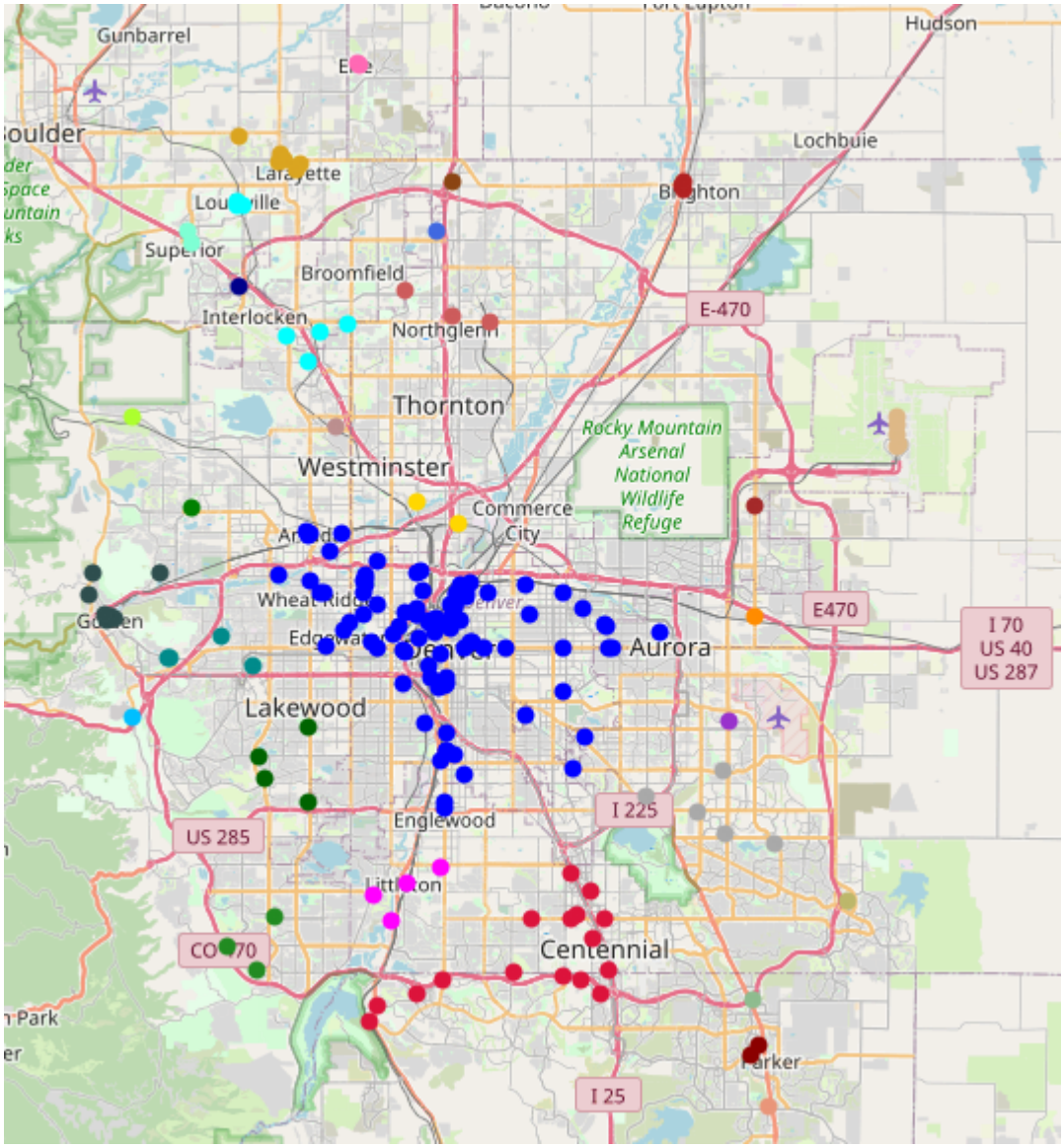
Agglomerative-Hierarchical



DBSCAN


DBSCAN Geospatial Census Place Clustering
Cluster
0
1
2
3
4
Latitude
40.1
40.0
39.9
39.8
39.7
39.6
39.5
−105.3
−105.2
−105.1
−105.0
−104.9
−104.8
−104.7
−104.6
−104.5
Longitude

Brewery Clustering via DBSCAN



* All model Figures are available as interactive plots which can be opened in a web browser