Wealth inequality, Residential segregation and allocation of essential venues for the neighborhoods in Atlanta, Georgia

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Introduction

- In several studies conducted by the Atlanta Housing Authority, Census Reporter, as well as a county poverty analysis of Georgia, Atlanta was found to be the city with the highest income disparity between residents, where the highest income earners in the region make nearly nine times more than the lowest income earners. This might be in due to the fact of the prevalence of high residential segregation in the area (Williams & Jackson, 2005). The area's high segregation and concentrated poverty are factors that add to this disparity, where the spatial proximity among adjacent neighbourhoods has a large impact on overall levels of racial segregation (Dawkins 2004). Atlanta, Georgia is highly segregated in terms of race and ethnicity (U.S Census Bureau 2018). Even after adjusting for socioeconomic status, and population, there are findings to show that residential segregation and income inequality had significant influence on physical activity and health of residents as well as access to health-care and educational resources (Saxton-Ross, 2009). Due to this heavy residential racial segregation, the income segregation amognst the cities residents persisted as well. Connecting residential segregation literature with urban geography and spatial analysis literature, a study by Ambinakudige et al. (2017) showed that temporal and spatial patterns of racial composition in Atlanta correlate with the economic development, income levels and urban sprawl in the Atlanta metropolitan statistical areas. Even though more and more urban neighborhoods are becoming racially diverse, the urban United States is still a residentially segregated society for the most part. The clustering of disadvantaged neighborhoods could make the residents of these neighborhoods face more failure in all socioeconomic fronts.

- In this study I explored the vast disparity between neighborhoods in terms of race and income-level affecting the presence of venues essential for neighborhood growth and well-being, such as all types of healthcare facilities and educational resources, such as elementary schools to trade schools. I applied the Foursquare API to search for these

venues in the surroundings of each community and clustered similar communities using instances of k-means clustering based on the frequency of the presence of the total number of those essential venues. The communities were defined either as one or a set of smaller set of neighborhoods in Neighborhood Statistical Areas (NSAs) as defined by the Atlanta Regional Commision and the Atlanta Housing Authority. The clusters were compared in terms of population demographic percentages as well as household income to give a better insight into the allocation of essential venues in each area and its correlated ties with wealth inequality and residential segregation in the region. The goal is for authorities in Atlanta to clearly identify neighborhoods at risk, as well as the disparity in the allocation of health-care and education resource venues to provide these resources for communities in need accordingly.

Data

The data I had pulled was from the Atlanta Regional Commission database from https://opendata.atlantaregional.com. One was the neighborhoods in Atlanta, their corresponding population demographics and their Neighborhood Statistical Area. I pulled two other sources of information concerning income data relating to each neighborhood in Atlanta as well as poverty by Neighborhood Statistical Area. All this data was collected very recently in 2018. To address the issues that arise from properly comparing neighborhood data, we use the already defined Neighborhood Statistical Areas (NSAs). These areas that are built from census blocks, have a minimum population of 2,000 and consist of either a single large neighborhood or a set of contiguous smaller neighborhoods. The geojson file of Atlanta statistical areas used to indicate boundaries on the maps was taken from the Atlanta Regional Commision. Essential resources for each community were searched using the Foursquare API based on the latitude and longitude of each community gathered utilizing the geopy python package. This data was used to compare the essential growth resources of each community and cluster them. Foursquare venue categories were taken from the comprehensive list of categories on Foursquare's official website and grouped into two different types representing access to health care facilities and access to education, ranging from preschool to college and trade level education.

Methodology

1. **Data Acquisition, Cleaning & Organization**

- Atlanta neighborhoods are "self-identified" by residents. As a result, there are hard to define boundaries for each particular neighborhood. As mentioned above, we used Neighborhood Statistical Areas, defined by the Atlanta Regional Commision to solve this problem. From the raw data we pulled, we seperated the relevant columns from each file such as neighborhood population, median household income, household sale price, population percentage living below the poverty line, and Neighborhood Statistical Area IDs. All data from the different files

were relational as each of the informational statistics provided were in accordance to the Neighborhood Statistical Areas.*

2. **Initial Exploratory Data Analysis and visualization**

- I created a histogram showing the distribution spread of household income per neighborhood, to show the disparity of total between how much the bottom 50% and top 50% of communities were earning.
- The disparity in income was explored using boxplots, histograms and descriptive statistics to visualize the spread of household income in all neighborhoods. I used the neighborhood population demographic data to visualize the household income disparity between communities that had a majority white population and communities that had a majority black & other minorities population. I used descriptive statistics to show the disparity of household income between the percentiles of the population, comparing the income value of the bottom 75% of the population with the top 25%.
- The distribution of household neighborhood income and population demographics, as well as the distribution of population percentages below the poverty line and percentage of white populations in the neighborhoods were visualized using scattergrams to visualize the trends and correlation between median household income, median house sale price and poverty in each neighborhood compared to the percentage of white population demographics in the neighborhood. I used boxplots to further signify the disparity of income and poverty levels between neighborhoods that had a majority white population (60% or above) and neighborhoods that had a majority black and minority population. All this data visualization helped illuminate the vast disparities in the different neighborhoods according to population demographics, showing high correlations between wealth disparity and residential segregation.

3. **Retrieval of GPS coordinates for each neighborhood**

- For each of the neighborhoods in Atlanta, I used the geopy package to retrieve each of their latitude and longitude values respectively. With 101 neighborhoods being analyzed, 37 of them came back with the problem of not having an exact name match to the neighborhoods in the database. This is mainly because of the problem concerning exact neighborhood boundaries, as I mentioned above. The coordinates could be out of place or missing due to the fact that several neighborhood names overlap with names of other locations throughout Atlanta. For example, the neighborhood Chastain Park might be getting confused with the Chastain Memorial Park, the largest city park in Atlanta. Other neighborhoods don't return GPS coordinates from using the geopy package at all. To overcome this, I used Google to manually input the coordinates for the 37 neighborhoods with either missing or out of place coordinate values.

4. Foursquare API for the most common venues

- First, in order to get a more comprehensive look on the the types of venues that were the most popular in each Neighborhood Area, I used Foursquare API to retrieve the trending venues of within a set radius around each community's GPS coordinates.
- I manipulated the data to produce the 5 most common occurring venues for each neighborhood. I then sorted this dataset in terms of household income for all the

neighborhoods in the dataset. I then merged the top 10 neighborhood data with the bottom 10 neighborhoods data to properly visualize the types of common venues in the neighborhoods of highest income disparity. I produced a list of the unique venue types most commonly found in low household income areas (High black and minority population demographics) and the unique venue types most commonly found in high household income areas(High white population demographics).

5. **Foursquare API category selection for essential venues for neighborhood growth**

- To delve further, I used the Foursquare API again to retrieve venues corresponding to a set radius around each community's GPS coordinates. Only this time, I retrieved venues corresponding to a certain category type, using the list of categories found on the Categories page of Foursquare website (https://developer.foursquare.com/docs/resources/categories).
- I selected category types relating to health-care, nutrition and education resources that were essential for a neighborhood's economic development, child opportunity index and health. I used a range of health-care facilities from acupuncturist to dentist offices and rehabilitation centers as well as a range of all available educational resources such as pre-schools to college and graduate-level education programs. I also included categories corresponding with healthy nutrition options in each neighborhood, such as supermarkets and organic food stores. All these categories were retrieved using the Foursquare API, and once retrieved were counted and stored in a dataset in accordance with each neighborhood.
- I sorted the data in terms of the neighborhoods with the highest amount of deemed essential resources and added the household income values, population demographics as well as poverty index for each of them with accordance to their Neighborhood Statistical Area ID. Here the disparity among neighborhoods was much clearer to visualize.

6. **K-means clustering for essential venues**

- The data for the total number of essential resource venues per neighborhood was normalized using the StandardScalar function, and then the 'elbow' method was performed with the sum of squared distances to find the optimal k value (number of clusters).
- K-means clustering was performed using the normalized data for total # of essential resources and the k value determined from the 'elbow' method. The different neighborhoods were clustered into different groups according to the distribution of essential resource venues, and analysis was performed to see if the allocation of these essential resources was indeed correlated with racial residential segregation and income level wealth inequality. We grouped the data according to the specific clusters and the mean value for population demographics, household incomes and poverty percentages for the neighborhoods in each cluster were returned. There was also a one-way ANOVA performed to see if there were indeed differences in median income levels of different clusters.

7. **Cluster Map Visualization**

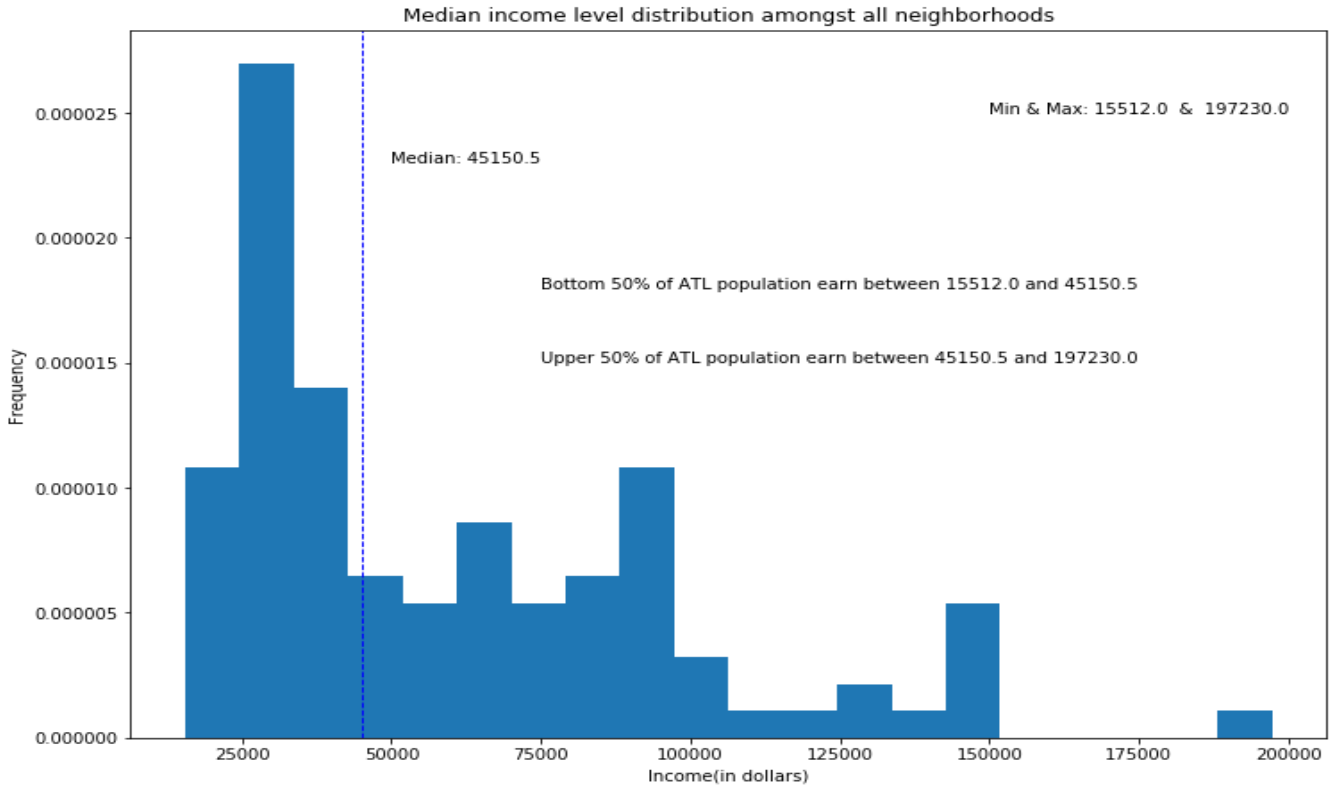
- Finally the Folium library was used to create a geographic map of the various communities in Atlanta, visualized by cluster separation using different colored markers for the communities in different clusters. It was used to fully visualize the spatial geographic spread of each

neighborhood and their corresponding group in total number of essential resource allocation in the area.

- A geojson layer was added to this map to visualize the boundaries for each Neighborhood Statistical Area, as determined by the Atlanta Regional Commision.

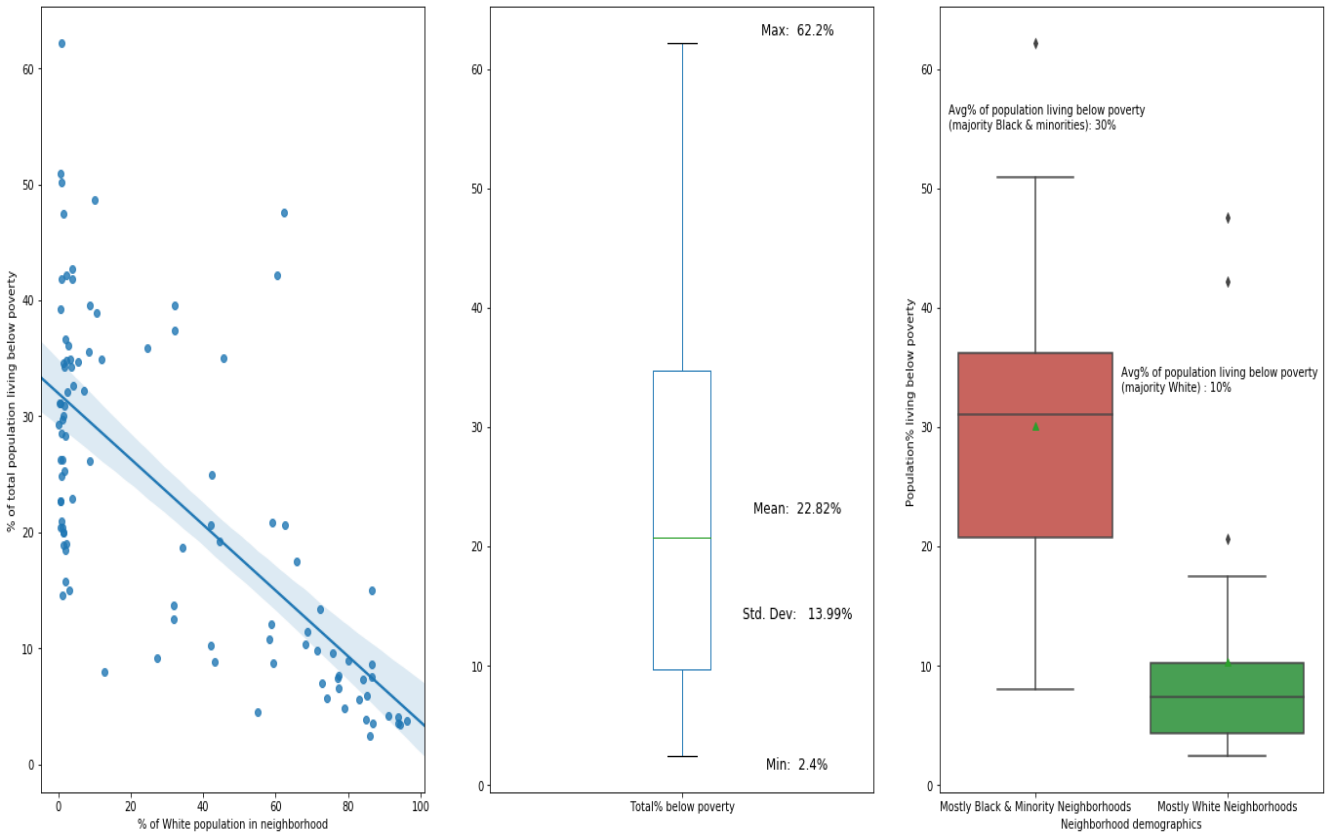
Results and Analysis

Figure 1: Histogram distribution of Median Household Income



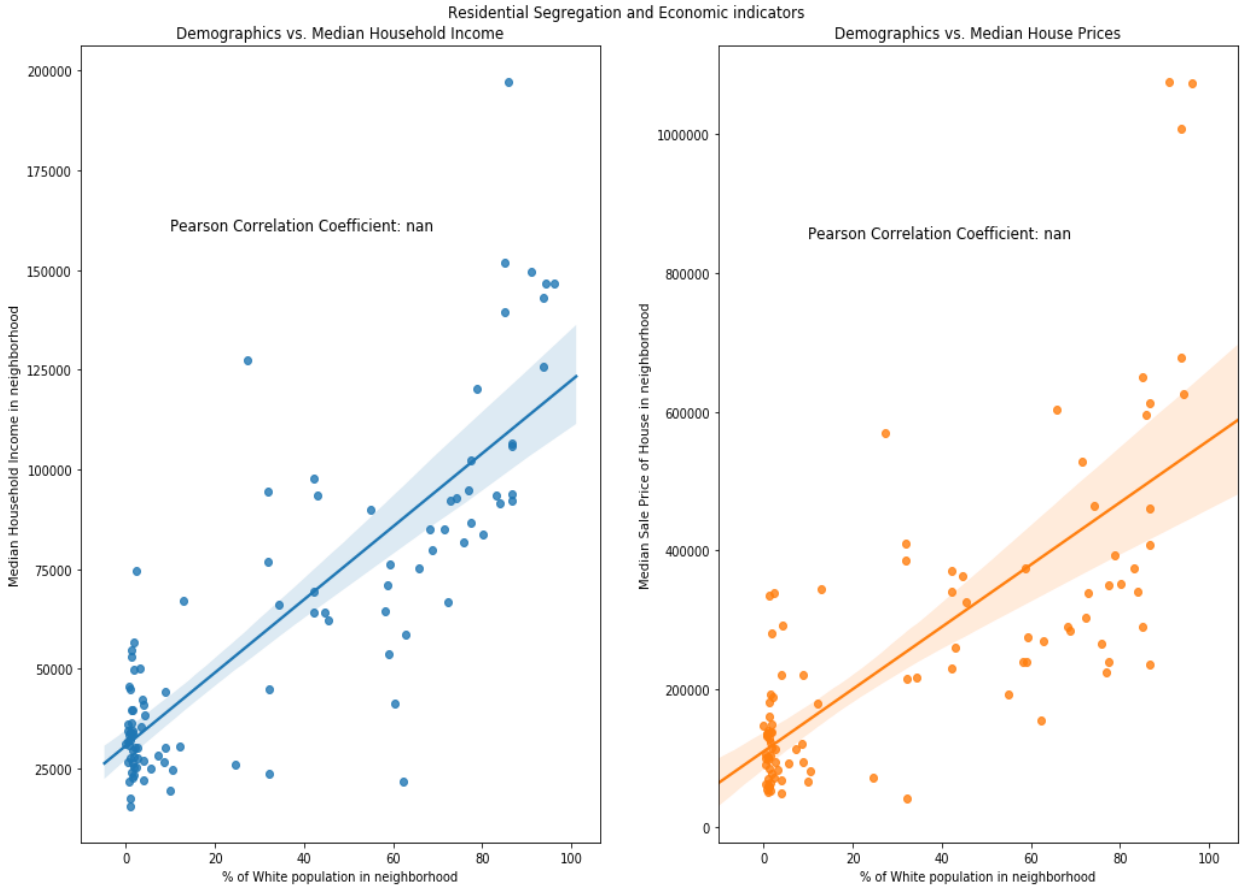
We can see the heavy skew of household income distribution, which reinforces the theory that Atlanta's extreme disparity problem. Using the median value of 45,618, we can see that the bottom half of the neighborhoods in Atlanta have a household income ranging from approximately 15,500 to 45,000, while the upper half of the neighborhoods in Atlanta have a household income ranging from 45,000 to 197,000. This is a significant disparity showing an intense income inequality as signified by the heavy right skew in the neighborhoods in Atlanta.

Figure 2: Visualizations for population percentage below the poverty line



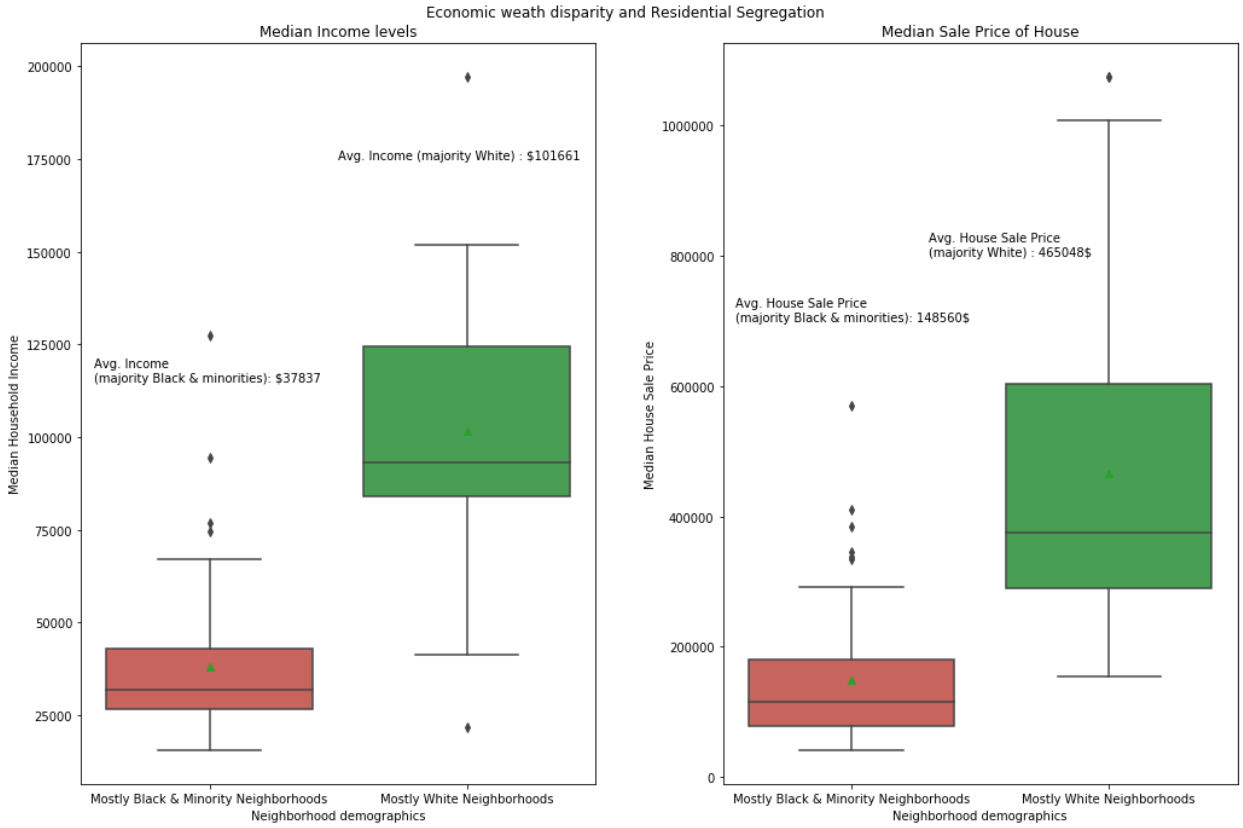
From the visualizations above, we can see there is a significant negative correlation between the percentage of a population living below poverty and the population demographics in an area. The higher the white population percentage in an area, the less the population poverty index amount is. From the box plot we can see that the bottom 50% of the neighborhoods have a total population percent living below the poverty line between 22.5% and 62.2%, while the upper 50% of the neighborhoods only experience around 2.4 to 22.5% of the population living below poverty, which is extremely significant. In neighborhoods that have a majority black and minority population, the average for the total percent of population below poverty is 30%, while for neighborhoods that have a majority white population, that statistic is only 9%.

Figure 3: Scatterplots of Demographics against Median Income and House Sale Price



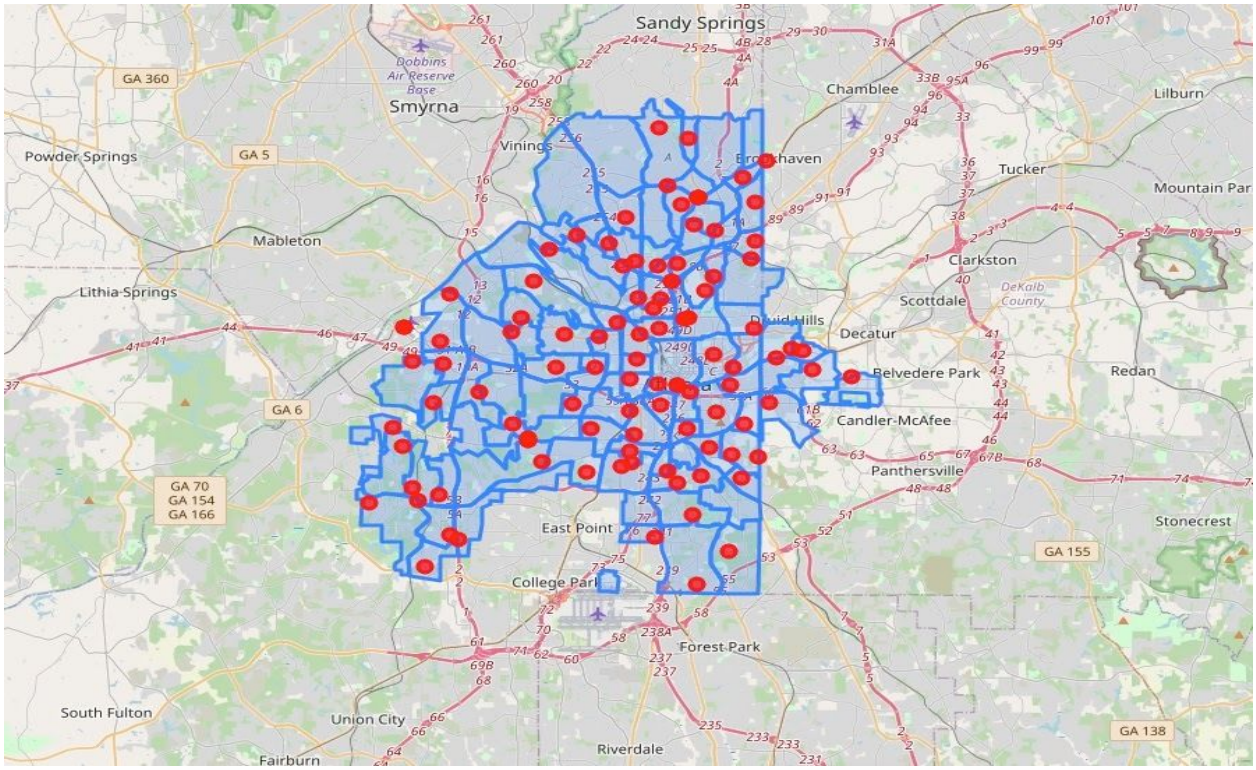
From the initial two scatterplots we can see that population demographics and factors such as median household income, and median house sale price are highly correlated. The correlation coefficient of 0.837 between percentage of white populations in neighborhoods and median household income, suggests a very distinguishable trend between residential segregation and higher income levels in all neighborhoods. We can see that the racial demographic of a certain community is key in its attribution for household income or house sale price. There is a very indistinguishable trend that can be determined between geographic residential segregation and wealth-disparity in all neighborhoods in Atlanta

Figure 4: Boxplot distribution of Income and House price levels, by racial majority



From the following two box plots comparing the range and distribution of household income and house sale price in terms of population demographics, we can see a clear disparity between the distributions between majority white populated neighborhoods compared to the majority black and other minority populated neighborhoods. The neighborhoods with a majority white population are much wealthier with an average household income of 103,739 dollars, while the neighborhoods with a majority black and other minority population are significantly less wealthy with an average household income of only 37,804 dollars. This disparity is also reflected in the distribution of house sale price in accordance to population demographics. There is a significant income disparity in the neighborhoods in Atlanta in accordance with the residential segregation present.

Figure 7: Map of Communities and Neighborhood Statistical Areas in Atlanta



Foursquare API- Top Five most common venues

The top 5 most common venues for each neighborhood were collected using Foursquare. This is an example of venues returned for 15 communities in the data set:

Top/Bottom	Communities	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	Community Area Number	Population	Median Income	Median Sale Price	Total% below poverty	White%	Black & Other Minority%
0	Arden/Habersham	Pizza Place	Grocery Store	Steakhouse	Café	French Restaurant	C04	2672.0	146424.0	1074000.0	3.7	96.3	3.7
1	Brookhaven	Department Store	American Restaurant	Cosmetics Shop	Shopping Mall	Pizza Place	B05	2335.0	146560.0	625000.0	3.4	94.4	5.6
2	Chastain Park	Park	Mexican Restaurant	Wings Joint	Grocery Store	Southern / Soul Food Restaurant	A03	3423.0	143001.0	1008000.0	3.5	93.8	6.2
3	Brandon	Park	Golf Course	Ski Trail	Outdoors & Recreation	Pool	C03	3516.0	125847.0	678030.0	4.1	93.7	6.3
4	Kingswood	Art Gallery	BBQ Joint	Caribbean Restaurant	Coffee Shop	Burger Joint	A02	4207.0	149398.0	1075000.0	4.2	91.0	9.0
5	Channing Valley	American Restaurant	Fast Food Restaurant	Big Box Store	Mexican Restaurant	Gas Station	C06	3757.0	105955.0	612500.0	3.5	86.7	13.3
6	Lake Claire	Park	American Restaurant	Breakfast Spot	Coffee Shop	Pizza Place	N04	2697.0	93637.0	407000.0	8.6	86.6	13.4
7	Ansley Park	Hotel	Grocery Store	Garden	Park	Seafood Restaurant	E01	3350.0	91984.0	460000.0	7.5	86.6	13.4
8	Peachtree Heights East	American Restaurant	Italian Restaurant	Steakhouse	Grocery Store	Coffee Shop	B10	3736.0	106595.0	234500.0	15.0	86.6	13.4
9	Margaret Mitchell	American Restaurant	Hotel	Southern / Soul Food Restaurant	Coffee Shop	Theater	A01	4061.0	197230.0	595000.0	2.4	85.9	14.1
10	Morningside/Lenox Park	Gay Bar	Grocery Store	Thai Restaurant	Italian Restaurant	Trail	F04	8307.0	151667.0	650000.0	5.9	85.2	14.8
11	East Chastain Park	Park	Mexican Restaurant	Grocery Store	Juice Bar	Southern / Soul Food Restaurant	B03	2092.0	139289.0	290000.0	3.8	85.0	15.0
12	Atkins Park	Bar	Trail	Coffee Shop	Grocery Store	Dessert Shop	F03	8475.0	91508.0	341250.0	7.3	84.1	15.9
13	Candler Park	Park	Bar	American Restaurant	BBQ Joint	Bookstore	N03	4742.0	93362.0	375000.0	5.6	83.1	16.9
14	Inman Park	Trail	Pizza Place	American Restaurant	Mexican Restaurant	Bar	N02	6196.0	83788.0	352500.0	8.9	80.2	19.8

When further analysis was performed, we got the results of:

Most common venue types in the 10 neighborhoods with highest White population demographics :

['American Restaurant', 'Art Gallery', 'BBQ Joint', 'Big Box Store', 'Breakfast Spot', 'Burger Joint', 'Café', 'Caribbean Restaurant', 'Coffee Shop', 'Cosmetics Shop', 'Department Store', 'Fast Food Restaurant', 'French Restaurant', 'Garden', 'Gas Station', 'Golf Course', 'Grocery Store', 'Hotel', 'Italian Restaurant', 'Mexican Restaurant', 'Outdoors & Recreation', 'Park', 'Pizza Place', 'Pool', 'Seafood Restaurant', 'Shopping Mall', 'Ski Trail', 'Southern / Soul Food Restaurant', 'Steakhouse', 'Theater', 'Wings Joint']

Most common venue types in the 10 neighborhoods with highest Black & minority population demographics :

['American Restaurant', 'Art Gallery', 'Bank', 'Breakfast Spot', 'Chinese Restaurant', 'Convenience Store', 'Cosmetics Shop', 'Discount Store', 'Fast Food Restaurant', 'Food', 'Fried Chicken Joint', 'Gas Station', 'Grocery Store', 'Intersection', 'Liquor Store', 'Mexican Restaurant', 'Mobile Phone Shop', 'Music Store', 'Park', 'Pharmacy', 'Pizza Place', 'Rental Car Location', 'Sandwich Place', 'Seafood Restaurant', 'Southern / Soul Food Restaurant', 'Spa', 'Storage Facility', 'Wings Joint']

We can see just based on this information the disparity in the heavy disparity proportion of white and black people in both these neighborhood types. The types of venues in higher income neighborhoods include an abundance of venues such as Cosmetic shops, Gyms, Golf Courses, Cafes and Art Galleries, while the types of neighborhoods in lower income neighborhoods include an abundance of venues such as Discount Stores, Liquor Stores, and Convenience stores. Although there are a few common types of venues between the

neighborhoods, I find that the venues that are not common speak huge volumes to the type of venue distribution.

Foursquare API- Essential Venue Category Selection

Factors that are essential for the growth and development of a neighborhood are health-care, nutritional and educational resources. In this Foursquare API call, I combed through the several categories and as explained in the methodology section and separated categories, along with their Foursquare ID to customize the venue search for each individual neighborhood.

The 5 Neighborhoods with the highest number of resources:

Neighborhoods	Total # of Essential Resources
Midtown	219
Kingswood	212
Margaret Mitchell	198
Capitol Gateway	194
Brookwood Hills	168

The 5 Neighborhoods with the lowest number of resources:

Neighborhoods	Total # of Essential Resources
Midwest Cascade	3
Browns Mill Park	3
Bankhead Courts	1
Ashview Heights	1
Airport	1

Once we look at the full list of total essential venues per neighborhood, we immediately notice the glaring disparity in the availability of healthcare, education and nutrition resources between the top and bottom neighborhoods. Neighborhoods like Midtown, Margaret Mitchell, Kingswood, and Capitol Getaway have nearly 200 or more essential resource venues in their neighborhoods, while neighborhoods like Baker Hills, Benteen Park, and Bankhead Courts have less than 5 total essential resource venues in the entirety of their neighborhoods. This is an extreme difference amongst the neighborhoods in Atlanta

Top 10 and bottom 10 communities in Atlanta sorted in terms of total number of resources:

	Area #	Neighborhoods	Latitude	Longitude	Median Income	Population	White%	Black & Other Minority%	Total% below poverty	Total # of Essential Resources
0	E06	Midtown	33.7862	-84.4019	62262.0	4706.0	45.5	54.5	35.0	219
1	A02	Kingswood	33.7491	-84.3902	149398.0	4207.0	91.0	9.0	4.2	212
2	A01	Margaret Mitchell	33.7814	-84.3846	197230.0	4061.0	85.9	14.1	2.4	198
3	T03	Capitol Gateway	33.7398	-84.4416	35359.0	3138.0	3.4	96.6	34.9	194
4	E04	Brookwood Hills	33.7908	-84.3984	64021.0	4167.0	42.3	57.7	25.0	168
5	B08	Garden Hills	33.8375	-84.3516	64478.0	8300.0	58.3	41.7	10.8	162
6	F04	Atlanta Industrial Park	33.8098	-84.3538	151667.0	8307.0	85.2	14.8	5.9	162
7	E01	Georgia Tech	33.7945	-84.3763	91984.0	3350.0	86.6	13.4	7.5	156
8	B01	Buckhead Forest	33.8363	-84.3878	94864.0	4874.0	77.0	23.0	7.4	152
9	B06	Buckhead Village	33.8496	-84.3575	92122.0	3143.0	72.8	27.2	7.0	152
85	I04	Ivan Hill	33.7698	-84.5072	30845.0	5681.0	0.7	99.3	22.7	5
86	G01	Almond Park	33.7994	-84.3926	42253.0	2083.0	3.6	96.4	34.3	5
87	V04	Benteen Park	33.739	-84.3985	30072.0	3786.0	2.1	97.9	42.2	4
88	I05	Center Hill	33.7455	-84.4875	35946.0	4996.0	0.5	99.5	22.7	4
89	H03	Baker Hills	33.7403	-84.5104	21541.0	4095.0	0.7	99.3	50.9	4
90	P06	Midwest Cascade	33.6765	-84.5019	49864.0	2428.0	1.9	98.1	18.5	3
91	Z04	Browns Mill Park	33.6859	-84.3824	26942.0	3837.0	3.9	96.1	42.7	3
92	G02	Bankhead Courts	33.7815	-84.4671	34226.0	3067.0	1.0	99.0	24.8	1
93	Y03	Ashview Heights	33.7138	-84.35	25436.0	2808.0	2.2	97.8	34.8	1
94	Y04	Airport	33.7048	-84.3785	24780.0	2157.0	10.5	89.5	38.9	1

Average number of education, health and nutritional resources for the top 10 communities: **177.5**

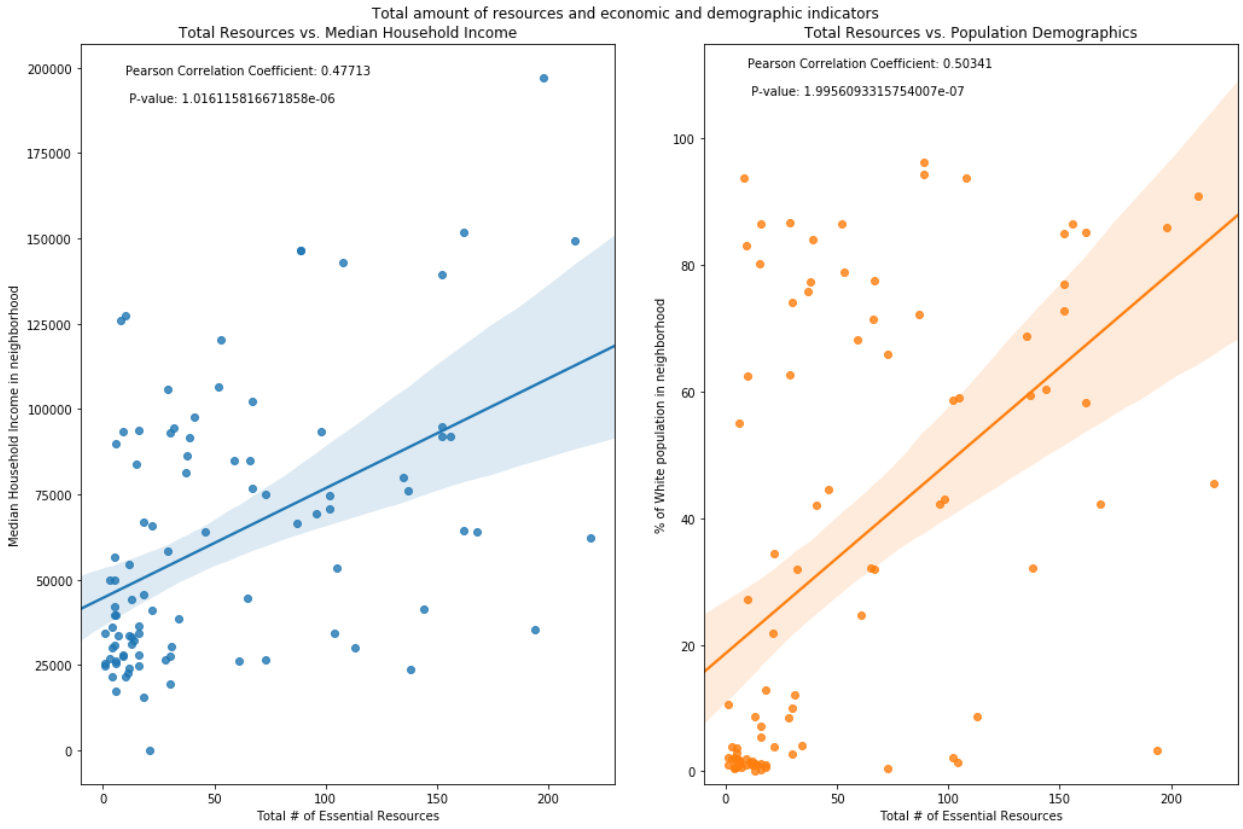
Average number of the same essential resources for the bottom 10 communities: **3.1**

The total number of essential resources for the top 25% of communities is **3309**

The total number of essential resources for all communities is **5136**

The number of essential-venue resources range from 1-3 (Bankhead Courts & Browns Mill Park) to 212-219 (Kingswood & Midtown). That is an extreme difference present in the allocation and spread of essential resources per neighborhood. When the top 10 and the bottom 10 communities are compared, the average number of resources are 177.5 and 3.1, respectively. The mean for total essential resource was higher than the median, indicating a positive skewness. The distribution of essential resource venues including healthcare facilities, educational resource facilities and nutritional resources shows the most disparity. The top 10 communities in terms of total number of essential resources accounted for almost 40% of the total number of essential resource facilities. The top 25% of the communities had 3309 resources, which is more than half the number of total educational, healthcare and nutrition resources for all the neighborhoods in Atlanta that were gathered from Foursquare.

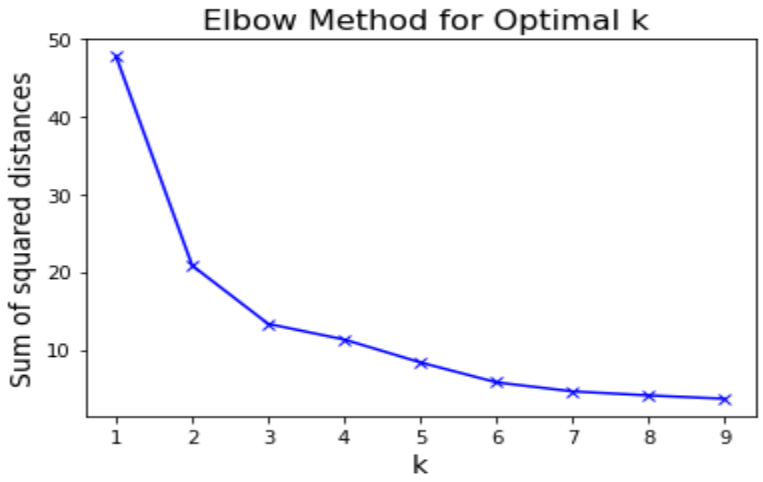
Figure 8: Scatterplot of Total Resources against Median Income and Population Demographic



Above are two scatter plots displaying the total number of essential resources against median household income as well as the total number of essential resources against total white population demographic percentage. Regression lines were plotted on both the scatter plots to demonstrate the positive correlation and relationship between number of resources against income levels and population demographics. The Pearson coefficient was 0.47713 for essential resources against income, which shows a moderate, but not strong, correlation between the two variables. In accordance with the p-value returned, it is also statistically significant at an α = 0.001 level. The Pearson coefficient was 0.50341 for essential resources against population demographics, which also shows a moderate, but imperceptibly higher, correlation between those two variables. In accordance with the p-value returned, it is also statistically significant at an α = 0.001 level

K-Means Clustering

After **normalizing** data using StandardScalar and performing **'elbow' method**:



Optimal K = 3

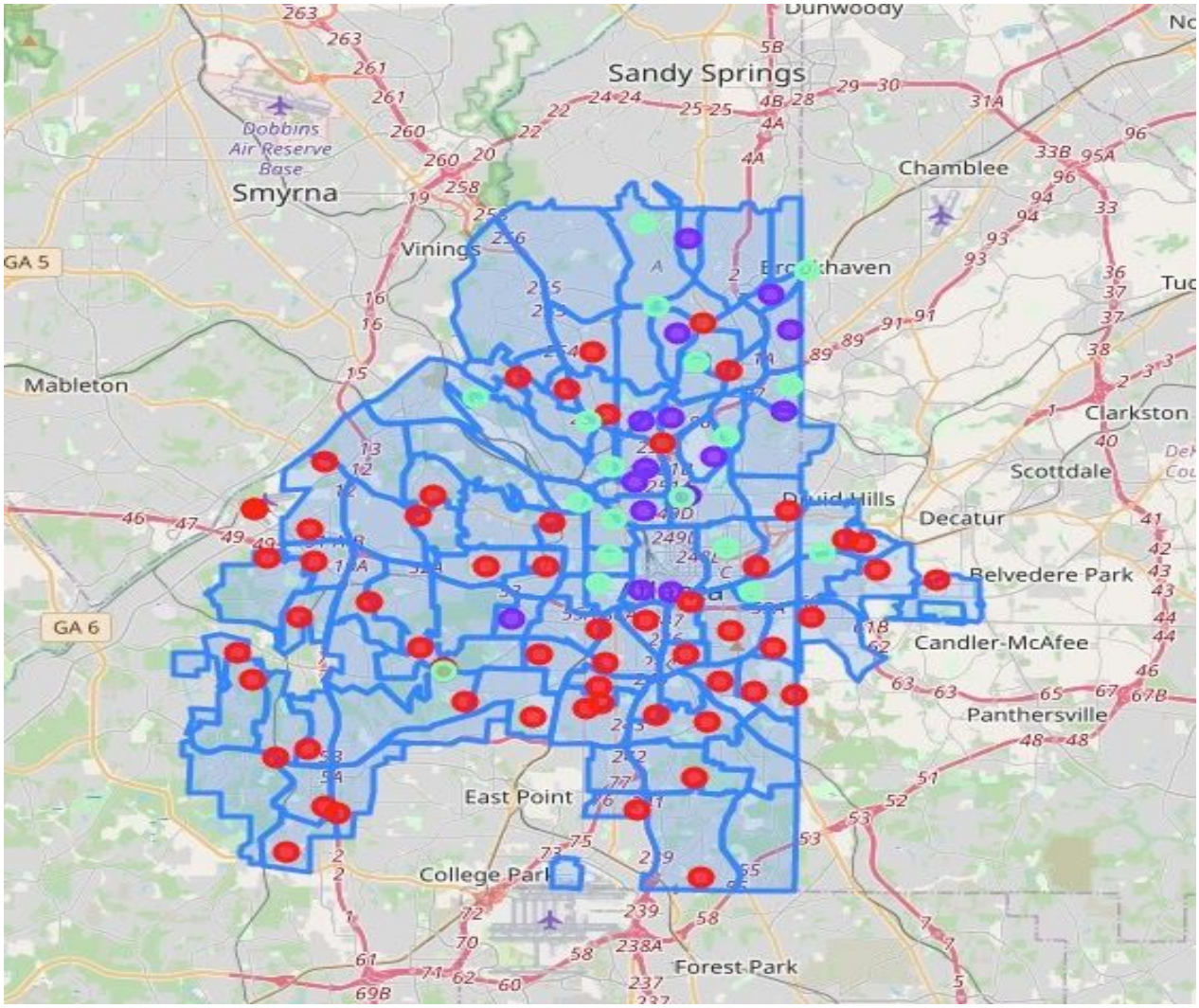
After **clustering** the data and **grouping** by those clusters:

Cluster	Median Income	Population	White%	Black & Other Minority%	Total% below poverty	Total # of Essential Resources
1	90926.066667	5239.000000	63.580000	36.420000	16.240000	165.400000
2	79857.857143	4718.142857	52.852381	47.147619	17.485714	82.333333
0	48308.423729	3701.508475	21.228814	78.771186	24.850847	15.694915

Using the 'elbow' method we can see that the communities are to be clustered into 3 different groups. The clusters were straightforward.Cluster 1 had communities with the most number of essential resources. We can see for all the clusters that population does not seem to have an effect on the number of resources, but demographics and income seem to. Cluster 1 communities have the highest average household income levels as well as the highest average white population demographic percentage. Cluster 2 can be characterized as having a significant number of essential resources, but much less than that of Cluster 1. Cluster 2 communities have an even spread in terms of population demographics and have the middle value for income levels amongst the rest of the communities. With Cluster 0, the average number of resources is significantly lower than that of Clusters 1 and 2. The income level for these groups of communities is the lowest across the board. The population demographics are heavily skewed, with the highest average black and other minority demographic percentages. When ANOVA was performed, the result was significant at $\alpha = 0.01$, indicating that median income, as well as white population percentage were indeed different across the clusters.

Figure 9: Map of Clustered Neighborhoods according to Total Resources

Cluster 0: Red marker **Cluster 1: Purple marker** **Cluster 2: Teal marker**



Among all the red dot clusters (Cluster 0), there is an average total of 16 essential resource venues amongst all of them. The teal dot clusters (Cluster 2), are neighborhoods that have an average total of 83 essential resource venues amongst, while the purple dot clusters (Cluster 1) have the highest average total of essential resources at 166. There are significantly more Cluster 0 communities compared to the amount of Cluster 1 communities. We can see the large disparity in the allocation of resources, showing an extremely high amount of neighborhoods in Atlanta with nearly no essential resource venues, while a small handful of neighborhoods with an extreme abundance of them.

Discussion

The communities in Atlanta were found to have a severe gap in median household income in 2018. These large income gaps were correlated with severe differences in population demographics as well, suggesting a high amount of residential segregation. Residents in neighborhoods such as

Margaret Mitchell had a median income level of nearly 198,000 dollars while residents in Greenbriar had a median income level of nearly 15,600 dollars. Such a wide gap in income was shown to have associations with the population demographics of the neighborhoods as well, with Margaret Mitchell having an 86% white population and Greenbriar having a 99% black and other minority population.

I used the value of Median Household Income as a factor, instead of mean income because Median Household Income is a much more accurate summary measure of income. Median household income is a more robust and accurate measure for summarizing income at the geographic level as compared to average household income since it is not affected by a small number of extremely high or low income outlier households.

In this study, the severe gap in median household income was shown to be significantly associated with availability of essential resources for neighborhood growth, such as healthcare and educational facilities as well as healthy nutrition resources. Among the categories used in the study, there was an extreme disparity in the total amount of essential resources, ranging from 0 to 219. This should be a severe concern for city officials as well as the residents. When the communities were grouped into clusters based on the number of total resources, the clusters also showed a straight-forward trend with the clusters having more essential resources having higher median incomes as well as higher white population percentages. The map we produced shows many communities belong to Cluster 0 and are mostly in the outskirts around the more wealthier neighborhoods and towards the south. This shows a serious segregation based on the location of communities. Efforts should be concentrated on bringing education, healthcare and nutrition resources to the communities in Cluster 0 that have the lowest median household income and the highest amount of black and other minority populations.

There are some shortcomings of this study that need to be addressed in a future study:

- I chose communities officially recognized by the regional commision of Atlanta. Neighborhoods might be better at representing an actual community that affects a person, but their boundaries often overlap, and there can be different neighborhoods depending on who you ask. However, the boundaries of community areas themselves also present a challenge. Except for a few communities that were annexed afterwards, these Neighborhood Statistical areas were charted in 1962 by researchers using available data back then. Using the same community areas as a unit of analysis is outdated, but the data was readily available, and it served as a good starting point.

- Since I chose to explore venues a certain distance away from a single GPS coordinate representing a community, the venues might be underrepresented or overrepresented, and the area surrounding the GPS coordinate may not be representative of the community area. In addition, the arbitrary 1250-meter radius should be revised to use an appropriate unit of analysis, which reflects the current situations and how people use the resources around them. Composition of communities should also be taken into consideration. Some extreme cases returned very few resources, maybe due to the fact that a large percentage of these community areas are lowly populated and have amounts of land that are parts of marshes, lakes, landfills, etc.

- Using Foursquare also presented a few challenges. There can also be redundancy in counting the venues of each category in this study. Although users do report duplicate listings, some can still exist, especially since different branches, departments can have their own listings on Foursquare and counted as separate venues. Along with the fact that there are many more venues in areas with dense populations, it is possible that the number of resources in the communities with many resources were over-represented. Some venues may not appear on Foursquare because of a number of reasons such as being newly opened or having some changes. However, I felt that these discrepancies are not enough to throw the whole picture.

Conclusion

There was such a wide disparity in the median income and population demographics in the communities that residents in Margaret Mitchell nearly made 180,000 more dollars than the residents in Greenbriar. These disparities in income and demographics seemed to stem from and have an effect on the gap in the allocation of the total number of essential resources. The clusters were straightforward.Cluster 1 had communities with the most number of essential resources. We can see for all the clusters that population does not seem to have an effect on the number of resources, but demographics and income seem to. Cluster 1 communities have the highest average household income levels as well as the highest average white population demographic percentage. Cluster 2 can be characterized as having a significant number of essential resources, but much less than that of Cluster 1. Cluster 2 communities have an even spread in terms of population demographics and have the middle value for income levels amongst the rest of the communities. With Cluster 0, the average number of resources is significantly lower than that of Clusters 1 and 2. The income level for these groups of communities is the lowest across the board. The population demographics are heavily skewed, with the highest average black and other minority demographic percentages. These Cluster 0 communities that had a substantially low number of essential resources, must be addressed, so that stakeholders and city officials can improve the infrastructure of those communities to bring in those essential resources. This study can be used to improve and effectively battle against the systemic residential segregation that prevails in this city. By taking small steps the immense income disparity in the city of Atlanta, Georgia can be combated.