LOCATION SELECTION FOR A CAR RENTAL BUSINESS IN ATLANTA, GEORGIA, USA

1. Introduction

1.1. Background

Atlanta is the capital of the U.S. state of Georgia. It is a growing city, home to Fortune 100 companies and headquarters of global corporations, with a growing and working population. In 2019, a report by the U.S Bureau of Labor Statistics showed that households in Atlanta spend 16.3% of the income on transportation, with 90.8% spent on purchasing and maintenance of vehicles [1]. This expenditure pattern is quite attractive to stakeholders who are focused on car rentals. Factors affecting car rentals include neighborhood economic activities and security. Neighborhood economic activities can point out areas of high human traffic areas, similar businesses or competition and supporting facilities such as restaurants and malls where customers can wait, or public transport that customers can use once dropping their cars.

On security, a quick browse through the news in Atlanta reveals that car theft is an issue that cannot be ignored. Car theft can result in financial losses due to replacement of stolen cars. It can also increase business risk, thus increasing insurance rates.

Information that gives an analysis of the neighborhoods in Atlanta and the crime statistics can therefore help stakeholders to make informed decisions on their business locations.

1.2. Problem

One of the sources of information for stakeholders is the internet. The internet provides general or piecemeal information which can be difficult to understand, put together and aid in making a decision. The risk then becomes that investors can make a decision to or not to invest based on such information.

This project aims to solve this problem by providing information that gives an analysis of the neighborhoods of Atlanta and crime statistics of the area, to aid in selection of a good location for a car rental business. By being aware of the surrounding businesses, the potential investor can go into the neighborhood with strategies on how to make his business unique. By also being aware of the vehicle theft statistics, the potential investor can also go into the neighborhood, being prepared to take measures that will minimize the chance of theft.

1.3. Interested stakeholders

This project and its findings will be of benefit to current and potential investors in the Atlanta. In addition, the methodology applied in the project can be adopted and refined by others to find solutions to similar problems in other areas. The Atlanta government can also benefit by making decisions based on the findings of this project to attract more investors.

2. Data acquisition and cleaning

2.1. Data sources and contents

The following datasets were obtained from the given sources:

i. Names of neighborhoods in Atlanta: The source of data for neighborhoods in Atlanta was the ARC's Open Data and Mapping Hub [2]. The data file was obtained in .xlsx format and contained data on the Neighborhood Planning Unit (NPU), names of neighborhoods and the geometry coordinates of each neighborhood. This source did not have the coordinates of each neighborhood.

ii. Coordinates of neighborhoods in Atlanta: To find coordinates of each neighborhood, Nominatim API and Googlemaps API was used. The latitude and longitude of neighborhood was returned.

iii. Places in the neighborhoods of Atlanta: After getting the neighborhoods in Atlanta, **FOURSQUARE LOCATION API** was used to explore the neighborhoods to find out data on the places, businesses and social activities going on. The data was put in JSON (JavaScript Object Notation) format to allow for cleaning.

iv. Crime data of neighborhoods in Atlanta: Crime data was sourced from Data World, a cloud-native data catalog [3]. The data was in .csv (comma separated values) format and showed the type of crime, date it occurred, location, latitude, longitude and the neighborhood.

v. To visualize various aspects in Atlanta, a GeoJSON (geospatial data interchange format based on JSON) file that defines the boundaries of each neighborhood was sourced from the Fulton County government GIS Portal [4].

2.2. Data cleaning

i. The data on neighborhoods had many columns including the population, NPU, statistical area, population, neighborhood, URL, area, races (white, black, Asian, other, Hispanic), Global ID,

and last edited date. Data type for each column was checked. In the neighborhood column, some neighborhoods were grouped together in one row since they belong to the same NPU. These were split so that each row had one neighborhood. The spellings of column names were checked and modified.

ii. Data from from Nominatim API and Googlemaps API did not need any cleaning. However, before fetching the coordinates from the API's, the words 'Atlanta, Georgia' were appended to each neighborhood to give the correct address. This is because a neighborhood like 'Downtown' in Atlanta can also be found in other areas such as Los Angeles.

iii. Data from Foursquare API was obtained in JSON format. The data was converted to a pandas dataframe. Category names were extracted from the categories column and a separate column created to hold this data.

iv. Crime data in the csv file was loaded as a pandas dataframe. It has columns including crime, number, date, location, beat, neighborhood, NPU, latitude and longitude. Columns 'number' and 'beat' were not necessary in this project and were therefore deleted. Spellings of column names were corrected.

v. The GeoJSON file containing boundary coordinates had characters such as braces and commas that were preventing it from loading. Using Visual Studio Code, all the unnecessary characters were manually removed.

2.3. Feature selection

After cleaning, examination of all the datasets revealed some redundancies. Feature selection was done as follows.

i. Examination of dataframe on neighborhoods showed that the population, NPU, statistica, population, neighborhood, URL, A, races (white, black, Asian, other, Hispanic, Global ID, and last edited date columns. Object ID, statistica, pop2010, URL, which give statistical data that in not necessary in this project. We therefore drop these columns. The potential investors will target all races; therefore, the races columns are dropped. The neighborhood column entries are similar to the A column, so we drop the A column. We therefore select only the NPU and the neighborhood. After cleaning the data was as follows:

Table 1: Neighborhoods in Atlanta

	NPU	Neighborhood
0	NPU C	Arden/Habersham
1	NPU C	Argonne Forest
2	NPU C	Peachtree Battle Alliance
3	NPU C	Wyngate
4	NPU B	Peachtree Heights East

ii. The NPU, Neighborhood from part i. above were concatenated with Latitude and Longitude data; these 4 features were then selected for use this project. This dataset was used to display each neighborhood on a map.

Table 2: Neighborhoods and coordinates of Atlanta neighborhoods

	NPU	Neighborhood	Latitude	Longitude
0	NPU C	Arden/Habersham	33.838360	-84.400194
1	NPU C	Argonne Forest	33.841380	-84.405448
2	NPU C	Peachtree Battle Alliance	33.822997	-84.398881
3	NPU C	Wyngate	33.832676	-84.397567
4	NPU B	Peachtree Heights East	33.826395	-84.381803

iii. From Foursquare output, the name, category, latitude, longitude and address were selected for use in this project to analyze the locations and provide information that will aid stakeholders in selection of a location. A sample of the data is shown below:

Table 3: Car rental businesses in Atlanta

	name	categories	lat	lng	formattedAddress
0	Sixt Rent A Car	Rental Car Location	33.772731	-84.384278	[659 Peachtree Street NE, Atlanta, GA 30308, U...
1	Budget Car and Truck Rental	Rental Car Location	33.758254	-84.384414	[140 Courtland Street NE, (SW corner Courtland...
2	Enterprise Rent-A-Car	Rental Car Location	33.742637	-84.387338	[450 Capitol Ave SE, Atlanta, GA 30312, United...
3	Enterprise Rent-A-Car	Rental Car Location	33.751171	-84.396477	[116 Ted Turner Dr SW, Atlanta, GA 30303, Unit...
4	Avis Car Rental	Rental Car Location	33.758292	-84.384072	[143 Courtland Street NE, Atlanta, GA 30303, U...

iv. From the crime data, crime number and beat were found to be redundant for this project and therefore dropped. The crime data was listed from the year 2010 to 2017. Data from 2010 to

2014 was found to be a little outdated and was therefore dropped. For the remaining dates, the features selected were crime, location (street address), neighborhood, NPU, latitude and longitude. A sample of the selected data is shown below:

Table 4: Crime data for neighborhoods in Atlanta

	crime	date	location	neighborhood	npu	lat	long
0	AUTO THEFT	10/31/2016	180 PONCE DE LEON AVE NE	Midtown	E	33.77285	-84.38149
1	AUTO THEFT	10/31/2016	2264 COUNTRY CLUB DR SW	Southwest	R	33.69384	-84.49398
2	AUTO THEFT	10/31/2016	2360 SANDSPRING DR SW	Sandlewood Estates	P	33.70174	-84.53788
3	AUTO THEFT	10/31/2016	51 BOOKER ST NW	Washington Park	K	33.75620	-84.42019
4	AUTO THEFT	10/31/2016	987 HILBURN DR SE	East Atlanta	W	33.72745	-84.32765

v. From the cleaned GeoJSON file, the necessary variable was the name of the neighborhood. This was selected together with the corresponding boundary coordinates and used in data visualization.

3. Methodology

In this Section, we detail the methodology used in selecting the best neighborhood and location for the car rental business, as well as detailed analysis of how we arrived at the choice. Our area of focus is ~2km around city center, Georgia State Capitol. We collected data on the neighborhoods in Atlanta, their locations, coordinates of neighborhood boundaries, car rental locations and top venues in each neighborhood according to Foursquare categorization and crime data. This is detailed in part 2 of this report.

Using this data, we begin by visualizing the neighborhoods and the corresponding car rental intensity for each. We analyze each are and identify areas that have a high, medium, low or zero density of car rental businesses. The output of this section are potential neighborhoods for car rental business. Car rental businesses do well when located in busy areas. To determine how busy and what is keeping the neighborhoods busy, we make use of Foursquare data and k-means clustering to group neighborhoods according to activities, thereby helping to identify promising areas for car rental businesses. Finally, crime data is analyzed according to neighborhoods. For each potential location, the crime information is availed. While crime cannot be avoided, knowledge of the crime rate can help a potential investor to strategize before setting up a business.

3.1. Visualization of neighborhoods in Atlanta

We made use of folium library to view the map of neighborhoods in Atlanta as shown in Figure 1. The neighborhoods are shown using blue-colored polygons while the Capitol is shown by a red popup.

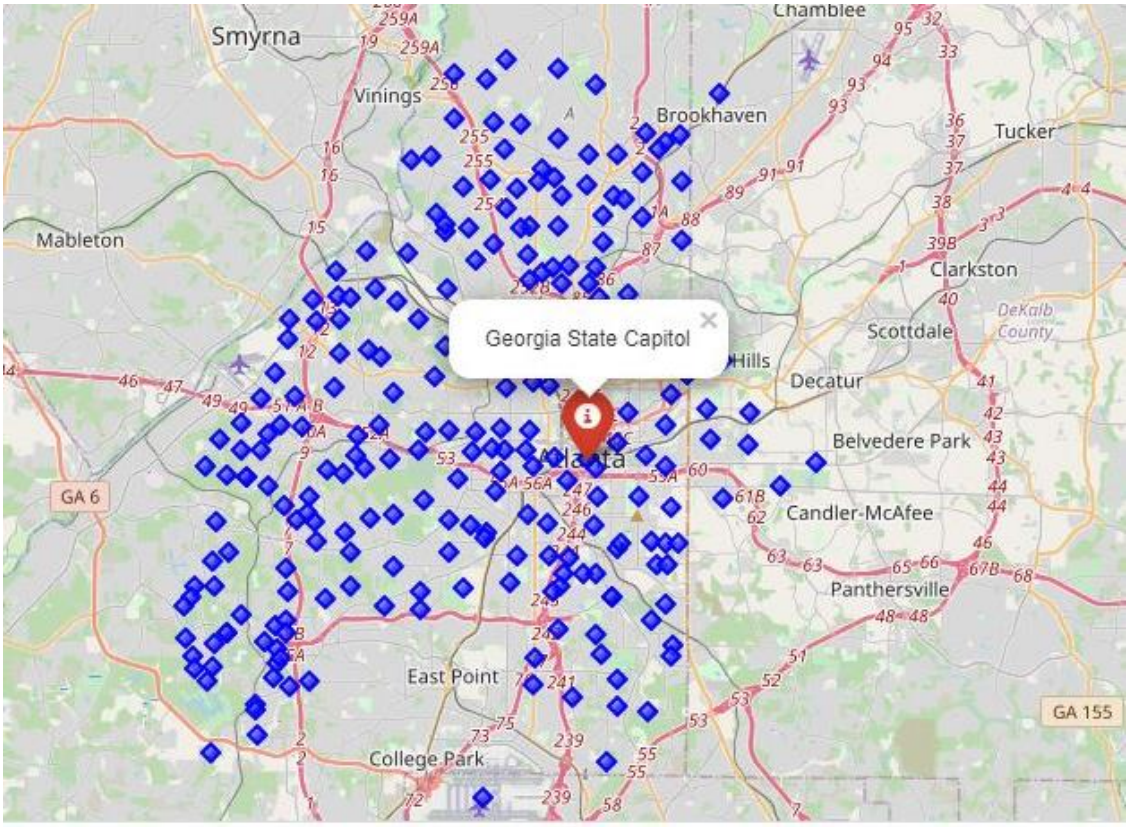

Figure 1: Neighborhoods of Atlanta

3.2. Exploring and visualization of car rental businesses in neighborhoods in Atlanta

Having obtained the locations of neighborhoods, we started analyzing each neighborhood to find out the current car rental services. In this project, the focus area is limited to a radius of ~2000m from the Atlanta Capitol. The neighborhoods within this area are: Downtown, Old Fourth Ward, Midtown, Castleberry Hill, Summerhill, Peopletown, Ormewood, Mechanicsville, Castleberry Hill, Sweet Auburn and The Villages at Castleberry Hill. We used Foursquare API to obtain the listed places that are categorized as rental, car or auto. We then used maps to visualizing these locations, together with their neighborhoods, as in Figure 2. A map of the neighborhood boundaries

was added to the map to show the clear locations of the car rental businesses. The car rentals are shown by red markers, radius of interest is shown by a red circle and the neighborhoods are shown by blue polygon markers. The map of neighborhood boundaries is shown in black-dashed lines.

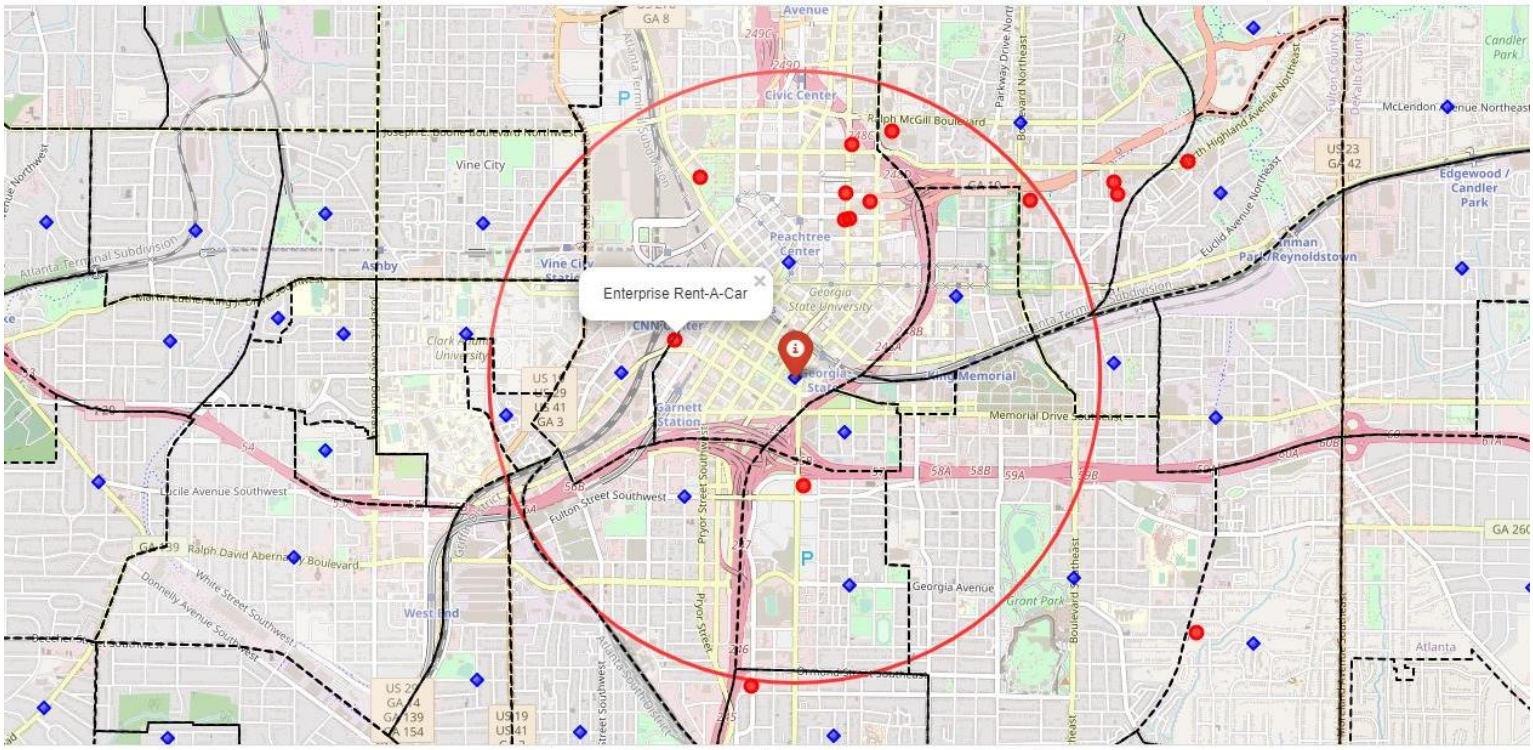

Figure 2: Car rental businesses in Atlanta

Looking at the map, we see that most car rentals (7 out of 15) are located in Downtown neighborhood, that houses the Georgia state Capital. This is expected since the Capital is the city's central business district, and therefore busy. A lot of local and international events, companies are also located in such cities, making them good places for business. 4 car rental businesses are located in Old Fourth Ward and the rest scattered in Midtown, Castleberry Hill, Summerhill, Peopletown and Ormewood.

In this project, we assume that the potential investors want to set up their business in an area that does not have any car rental business. From the above analysis, we know the neighborhoods to avoid: Downtown, Old Fourth Ward, Midtown, Castleberry Hill, Summerhill, Peopletown and Ormewood. From the map, the neighborhoods within our radius that do not have any car rental

service include Mechanicsville, Castleberry Hill, Sweet Auburn and The Villages at Castleberry Hill. We now focused on these neighborhoods.

3.3. Exploring places in neighborhoods in Atlanta

We recognize that rentals tend to do better in places that are visible and with more human traffic. Th question then is, do the neighborhoods of Atlanta have venues that make them busy places? To answer this question, we go back to Foursquare to explore activities in Atlanta neighborhoods. We limit our search to a radius of 500m for each neighborhood. Since our interest is in the selected potential neighborhoods: Mechanicsville, Castleberry Hill, Sweet Auburn, The Villages at Castleberry Hill, we look at the venues in these neighborhoods. Some of the venues in the neighborhoods are shown in Table *5*:

Table 5:Venues in some selected neighborhoods

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Castleberry Hill	33.749285	-84.400194	Bottle Rocket	33.750109	-84.400979	Sushi Restaurant
Castleberry Hill	33.749285	-84.400194	No Mas! Cantina	33.749785	-84.400847	Mexican Restaurant
Castleberry Hill	33.749285	-84.400194	Castleberry Hill	33.748233	-84.401736	Neighborhood
Castleberry Hill	33.749285	-84.400194	Wine Shoe	33.751559	-84.398937	Wine Shop
Castleberry Hill	33.749285	-84.400194	Spin	33.747649	-84.401864	Lounge
Castleberry Hill	33.749285	-84.400194	Old Lady Gang	33.749664	-84.399405	Southern / Soul Food Restaurant
Castleberry Hill	33.749285	-84.400194	Nelson Street Gallery	33.751228	-84.399390	Art Gallery
Castleberry Hill	33.749285	-84.400194	Besharat Gallery	33.749818	-84.399375	Art Gallery
Castleberry Hill	33.749285	-84.400194	ADios Cafe	33.750037	-84.400994	Café
Castleberry Hill	33.749285	-84.400194	Castleberry Hill Art Stroll	33.751395	-84.399335	Art Gallery
Castleberry Hill	33.749285	-84.400194	Atlanta Movie Tours	33.751586	-84.398570	Moving Target

To better understand the neighborhoods, we cluster them neighborhoods based on their venues or activities. K-mean clustering for unsupervised data is selected as the machine learning method that will enable us to further understand the neighborhoods. The clusters help to understand the patterns of the neighborhoods.

The data obtained on venues from Foursquare is categorical and we prepare it to numerical data for machine learning. We prepared our venues dataset by applying one hot encoding and grouping to generate a dataset that can be used in fitting a k-means model to give us the clusters. We applied the ‘elbow method’ to find the best number of clusters, which gave us 5 clusters. We then created

a k-means function and fitted it on the data to create 5 clusters. We got our clusters and added them to each neighborhood to see what pattern is prominent in the neighborhood in terms of venues

Our areas of interest were Mechanicsville, Castleberry Hill, Sweet Auburn, The Villages at Castleberry Hill, so we focus on these areas. A scan through the clustered data revealed that only 2 neighborhoods: Mechanicsville and Castleberry Hill returned results. The rest of the neighborhoods: Sweet Auburn, The Villages at Castleberry Hill did not return any venues. The clusters are shown below:

Table 6: Clusters of potential neighborhoods

Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
Castleberry Hill	33.749285	-84.400194	3	Lounge	Art Gallery	Café	Cosmetics Shop	Boutique	Southern / Soul Food Restaurant	Moving Target	Sushi Restaurant	Mexican Restaurant	Strip Club
Mechanicsville	33.741968	-84.395741	3	Recreation Center	Convenience Store	Shipping Store	Sandwich Place	Gas Station	Paper / Office Supplies Store	Flea Market	Fish Market	Fish & Chips Shop	Flower Shop

3.4. Atlanta crime analysis

Security is important in selection of a business location. In Atlanta, the crime statistics showed that auto theft occurs. To better understand the auto theft crime statistics of each neighborhood, we summed up all the auto theft incidents per neighborhood. We then used Choropleth map to view the crime statistics of each neighborhood. The map is shown in Figure 3. A look at the choropleth map revealed that the highest crime rates were in the following neighborhoods: Downtown Atlanta, Midtown, West End and Sylvan Hills. Figure 3 also shows 4 popups indicating the 4 neighborhoods of interest: Mechanicsville, Castleberry Hill, Sweet Auburn, The Villages at Castleberry Hill.

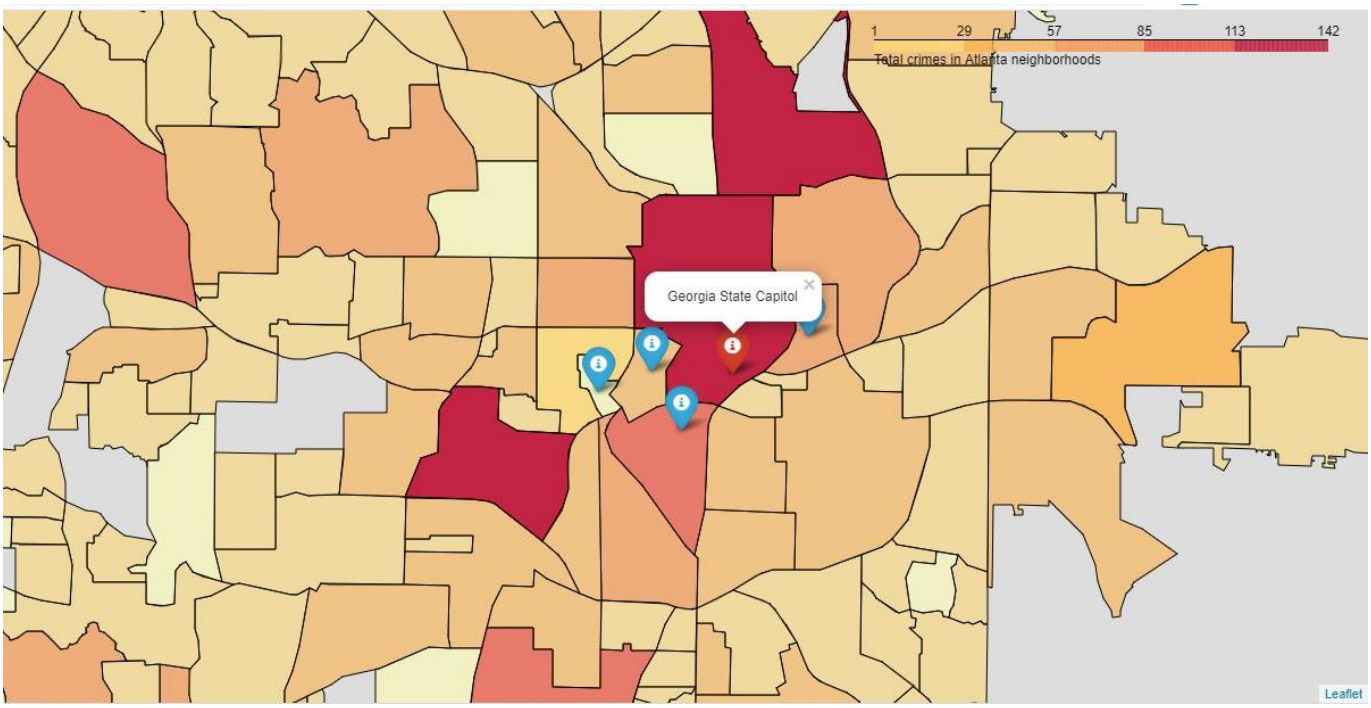

Figure 3: Car theft numbers in Atlanta neighborhoods

4. Results

Visualization of the Atlanta map in Figure 1 showed quite a number of neighborhoods in Atlanta well scattered over the city. Our area of interest in this project was ~2000m radius of interest from the Capital. In Figure 2, we can see that there are 10 neighborhoods. In these 10 neighborhoods, 15 car rental businesses were found. 7 of them were found in Downtown Atlanta and 4 in Old Fourth Ward. The rest of the car rental businesses were scattered in Midtown, Summerhill, Peopletown and Ormewood. This gives a total of 6 out 10 neighborhoods. The neighborhoods that did not have any car rental business were 4, namely: Mechanicsville, Castleberry Hill, Sweet Auburn and The Villages at Castleberry Hill. We called these the potential neighborhoods.

Another set of information that can be of help to a potential investor is the economic and social activities that are top in each neighborhood. In subsection 3.3, the results of k-mean clustering showed 5 clusters. An examination if these clusters showed that:

- Cluster 0 was given the name exercise/fitness and market cluster as its top venues included gym/yoga centers and markets.

- Cluster 1 was given the name relaxation and farm/farmers cluster as its top venues included parks and farms/farmers areas.
- Cluster 2 was called the sight-seeing or cluster as the top venues were historic sites and exhibits.
- Cluster 3 was seen to be dominated by eating venues and lounges, and was grouped as the restaurant cluster. Places such has Downtown, Atlanta's city's central business district, fell under this cluster.

Where do our potential neighborhoods fall?

Table 7: Cluster of potential neighborhoods in Atlanta

Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
Castleberry Hill	33.749285	-84.400194	3	Lounge	Art Gallery	Café	Cosmetics Shop	Boutique	Southern / Soul Food Restaurant	Moving Target	Sushi Restaurant	Mexican Restaurant	Strip Club
Mechanicsville	33.741968	-84.395741	3	Recreation Center	Convenience Store	Shipping Store	Sandwich Place	Gas Station	Paper / Office Supplies Store	Flea Market	Fish Market	Fish & Chips Shop	Flower Shop

Table 7 shows that they fall in cluster 3, the restaurants cluster. Table 7 also reveals that of the 4 potential venues that we started out with, namely: Mechanicsville, Castleberry Hill, Sweet Auburn and The Villages at Castleberry Hill, only Mechanicsville, Castleberry Hill have significant activity going on. The neighborhoods with no venues, namely: Sweet Auburn and The Villages at Castleberry Hill, were therefore dropped from our potential locations.

We further looked at the 2 potential neighborhoods, Mechanicsville, Castleberry Hill, and found that Castleberry Hill had more restaurants and lounges and can therefore be a good potential location for a car rental business.

Security was out final concern. Looking at the choropleth map in Figure 3, which displayed crime statistics in Atlanta neighborhoods, we observed some car theft hot spots. These included Downtown Atlanta, Midtown, West End and Sylvan Hills. None of our potential locations fell under the hot areas. However, looking at our selected neighborhoods, we saw that Mechanicsville had a higher crime rate than Castleberry Hill. This made Castleberry Hill the best potential

neighborhood selected. Narrowing down the location, we looked at the locations of venues in Castleberry Hill and grouped them. The final potential locations were therefore identified as:

i. ~196 m radius from 359 Nelson St SW, Atlanta
ii. ~100 m radius from 267 Peters St SW, Atlanta
iii. ~185 m radius from 172 Haynes St SW, Atlanta

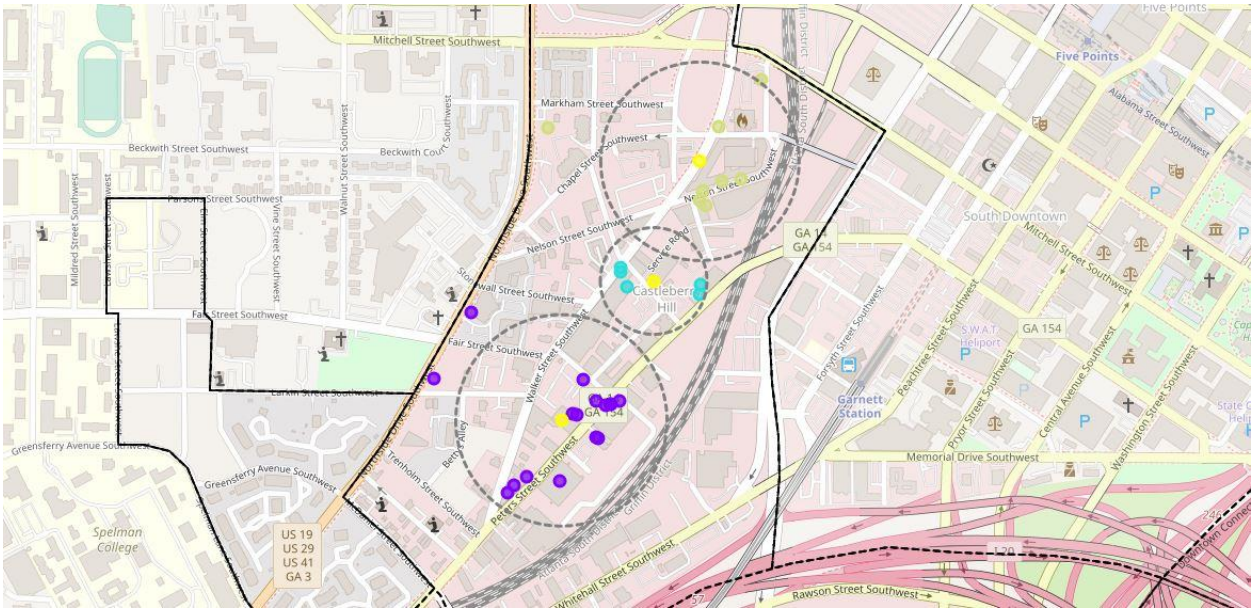

Figure 4: Final locations for car rental business i Atlanta

5. Discussion

The analysis carried out in this project showed that there are quite a number of car rental services in the neighborhoods of Atlanta. Majority of them are in Downtown Atlanta, which houses the Georgia State Capital. Other neighborhoods such as in Midtown, Summerhill, Peopletown and Ormewood had a few car rental businesses. It was also observed that within ~2000m from the Capital, 4 neighborhoods did not have a single car rental business. They were identified as Mechanicsville, Castleberry Hill, Sweet Auburn and The Villages at Castleberry Hill, and were our 4 potential neighborhoods.

An analysis of the venues in the Atlanta neighborhoods revealed that majority of the venues are restaurants or eating venues. In Downtown Atlanta, the central business district, restaurants were the top venue. Considering out 4 potential neighborhoods, it was also observed two neighborhoods,

Sweet Auburn and The Villages at Castleberry Hill, did not have any significant venues. This left 2 neighborhoods, Mechanicsville and Castleberry Hill. However, Mechanicsville was less busy as compared to Castleberry Hill.

With 2 potential neighborhoods, we continued narrowing down our search by analyzing the crime statistics in Atlanta. A general observation was made that car theft existed in Atlanta, with Downtown, Midtown and West End being the neighborhoods with the highest car theft numbers. Looking at our 2 potential neighborhoods, we observed that Mechanicsville had more car theft numbers than Castleberry Hill. This made Castleberry Hill a safer and having more human traffic.

Further narrowing down was done by analyzing the venues in Castleberry Hill to determine the 'hot spots' where busy venues are located. The venues in Castleberry Hill were grouped into 3 and potential locations narrowed identified as using the radius of and area. The final potential locations were ~196 m radius from 267 Peters St SW, ~100 m radius from 172 Haynes St SW and ~185 m radius from 359 Nelson St SW, Atlanta.

We therefore recommend that the stakeholders consider the 3 identified potential locations in Castleberry Hill when looking to set up a business. They should however keep in mind that car thefts have been recorded in the area. Strategies to prevent car theft should therefore be defined before the business is set up. With the names of the existing car rental businesses, stakeholders can carry out research on how the existing businesses operate, what strategies they use in makes their businesses successes and failure points.

6. Conclusion

In this study, an analysis was done of the neighborhoods in Atlanta, to help potential car rental business people to narrow down their search for the best potential neighborhood and locations for the business. The recommendation was to be based on neighborhood activities from Foursquare API and crime statistics. We collected data on the neighborhoods, activities and crime statistics. We identified the area of focus in this study, which were neighborhoods within 2km radius from the Georgia State Capital. An analysis of the car rental businesses in the focus area revealed potential neighborhoods with no car rental businesses. Clustering of the venues in these

neighborhoods narrowed our search to busy neighborhoods with more human traffic. These were Mechanicsville and Castleberry Hill, although Castleberry Hill had more busy venues. Analysis of the Atlanta crime data showed that the crime rate in Mechanicsville had been more than that in Castleberry Hill. Castleberry Hill was therefore selected as the best neighborhood.

Final narrowed-down location recommended to stakeholders were determined based on the grouping of venues Castleberry Hill. Centers of each grouping were used to define the radius covered by each potential location.

References

[1] Consumer Expenditures for the Atlanta Metropolitan Area: 2017–18, U.S. Bureau of Labor Statistics

[2] City of Atlanta Neighborhood Statistical Areas, retrieved on 24th June 2020, from https://opendata.atlantaregional.com/datasets/d6298dee8938464294d3f49d473bcf15_196

[3] Crime in Atlanta 2009-2017, dataset by Alexander Bryant, retrieved on 24th June 2020, from https://data.world/bryantahb/crime-in-atlanta-2009-2017

[4] Atlanta City Limits, retrieved on 24th June 2020, from https://gisdata.fultoncountyga.gov/datasets/b711dbcf5a1d4f479e275b1781c4bda0_1?geometry=-91.846%2C32.119%2C-77.025%2C35.316