



Moving to Palm Beach County Florida Data Analysis

<https://www.linkedin.com/pulse/moving-palm-beach-county-florida-data-analysis-linda-l-lichtenstein>

As I find myself in the process of moving to Palm Beach County, Florida, I decided to use this as my Capstone Project - Battle of the Neighborhoods – for the IBM Data Science Professional Certificate.

Introduction: Business Problem

Currently trending, many active seniors, especially those who live in states like New York and New Jersey, once retired, look to relocate to a warmer, less expensive location like Florida. They would like to move to an area where they can still enjoy many of the same activities in their new home as they enjoyed in their northern one, while maintaining a comparable quality of life in terms of affordability and demographics.

An important consideration for active seniors is to move to an area that is close to family and friends, as well as an area that their guests, including grandchildren, can enjoy visiting. For this study, that area will be limited to Palm Beach County, Florida. Palm Beach County is a large area - 2,386 square miles - on the east coast of Florida consisting of 39 municipalities.

Although there are many factors to consider when moving to a new neighborhood such as available social activities, recreational activities, access to healthcare, as well as the crime rate, taxes, affordability, and public amenities including transportation, this study will focus on venue data collected by FOURSQUARE.

FOURSQUARE provides a variety of categories of venues such as restaurants, shopping, and leisure activities. This study will cluster neighborhoods (municipalities) in Palm Beach County, Florida by venues collected from FOURSQUARE. In addition, median income, median property value, population density, and area (square miles) data will be collected and analyzed.

The goal of the analysis is to provide seniors with information that will help them make a better determination as to which areas they should explore further when considering relocation to Palm Beach County, Florida.

Data

I collected data from the following sources:

- geopy.geocoders Nominatim from which I retrieved latitude and longitude for Palm Beach County and each municipality in order to display Folium maps of Palm Beach County and its municipalities.
- I retrieved Palm Beach County municipality demographic information from the homefacts.com website. Data retrieved includes Median Income, Median Property Value, Population, Population Density, and Area. These values are from 2016.

The 39 municipalities in Palm Beach County are Atlantis, Belle Glade, Boca Raton, Boynton Beach, Briny Breezes, Cloud Lake, Delray Beach, Glen Ridge, Golf, Greenacres, Gulf Stream, Haverhill, Highland Beach, Hypoluxo, Juno Beach, Jupiter, Jupiter Inlet Colony, Lake Clarke Shores, Lake Park, Lake Worth, Lantana, Loxahatchee Groves, Manalapan, Mangonia Park, North Palm Beach, Ocean Ridge, Pahokee, Palm Beach, Palm Beach Gardens, Palm Beach Shores, Palm Springs, Riviera Beach, Royal Palm Beach, South Bay, South Palm Beach, Tequesta, Wellington, West Palm Beach, and Westgate.

- I called the FOURSQUARE API to retrieve venues trending at the time of execution including restaurants, shopping, leisure activities, etc. for Palm Beach County neighborhoods (municipalities).

I used pandas and python to perform the analysis for my project.
The data was read from an Excel file into the following pandas DataFrame.

| | Municipality | Latitude | Longitude | Median Household Income | Median Property Value | Population | Area - sq miles | Population Density - people per sq mi |
|---|---------------|----------|-----------|-------------------------|-----------------------|------------|-----------------|---------------------------------------|
| 0 | Atlantis | 26.5909 | -80.4494 | 76641 | 316100 | 1883 | 1.44 | 1309.45 |
| 1 | Belle Glade | 26.6845 | -80.6676 | 26859 | 94000 | 17597 | 5.71 | 3079.62 |
| 2 | Boca Raton | 26.3587 | -80.0831 | 68804 | 418100 | 87848 | 31.29 | 2807.81 |
| 3 | Boynton Beach | 26.5256 | -80.0666 | 53188 | 206100 | 70120 | 16.51 | 4247.63 |
| 4 | Briny Breezes | 26.5094 | -80.055 | 38274 | 147800 | 702 | 0.11 | 6324.32 |

Figure 1. pandas DataFrame of data read from an Excel file (first 5 rows)

Methodology

To visualize Palm Beach County and its municipalities, I generated two Folium maps. The first marks the location of Palm Beach County within the state of Florida; the second marks each municipality within Palm Beach County. The second map also incorporates popups with demographic information.

I created histograms and bar charts to visualize demographics of each of the municipalities as they relate to each other and to the whole.

The goal of this project is to group municipalities that have similar venues. Due to the nature of the municipality data, labeling is not possible; and therefore, requires an unsupervised method of analysis. I chose KMeans for my analysis because it is an unsupervised algorithm that clusters data into groups based upon their similarities.

Display Maps of Palm Beach County and Neighborhoods

Palm Beach County Map

The first of two maps places Palm Beach County in context to its location in Florida. I called Nominatim to get the latitude and longitude of Palm Beach County which were then used to generate the following Folium map.

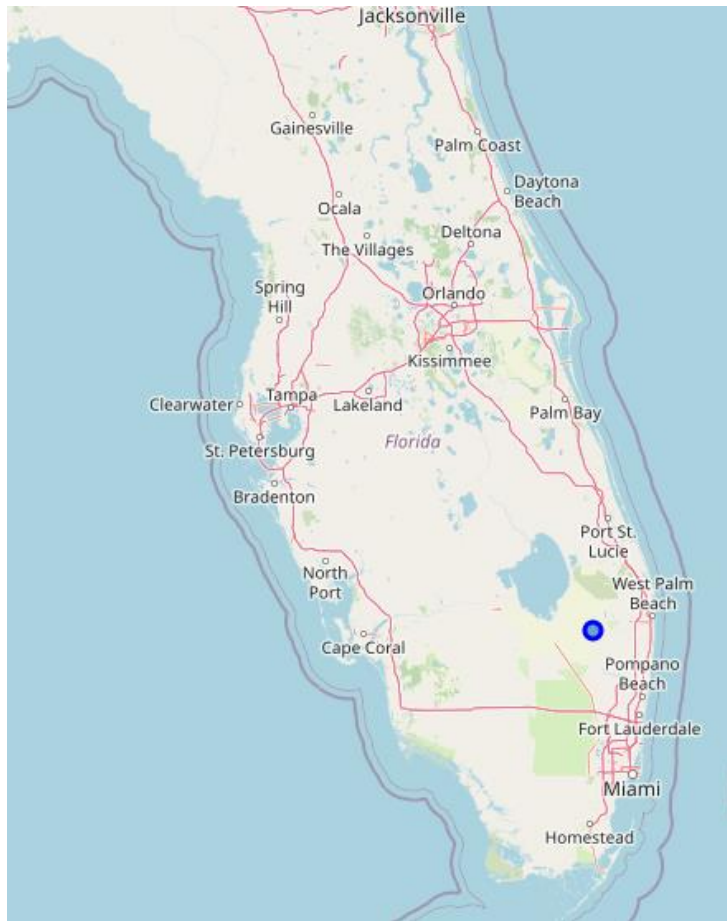


Figure 2. Florida map with Palm Beach County identified by the blue dot

Palm Beach County Neighborhoods Map

The second map places neighborhoods (by municipality) in context to their locations within Palm Beach County. In the same manner as the first map, I obtained the latitude and longitude of each municipality in Palm Beach County from Nominatim so that Folium could generate the following map.

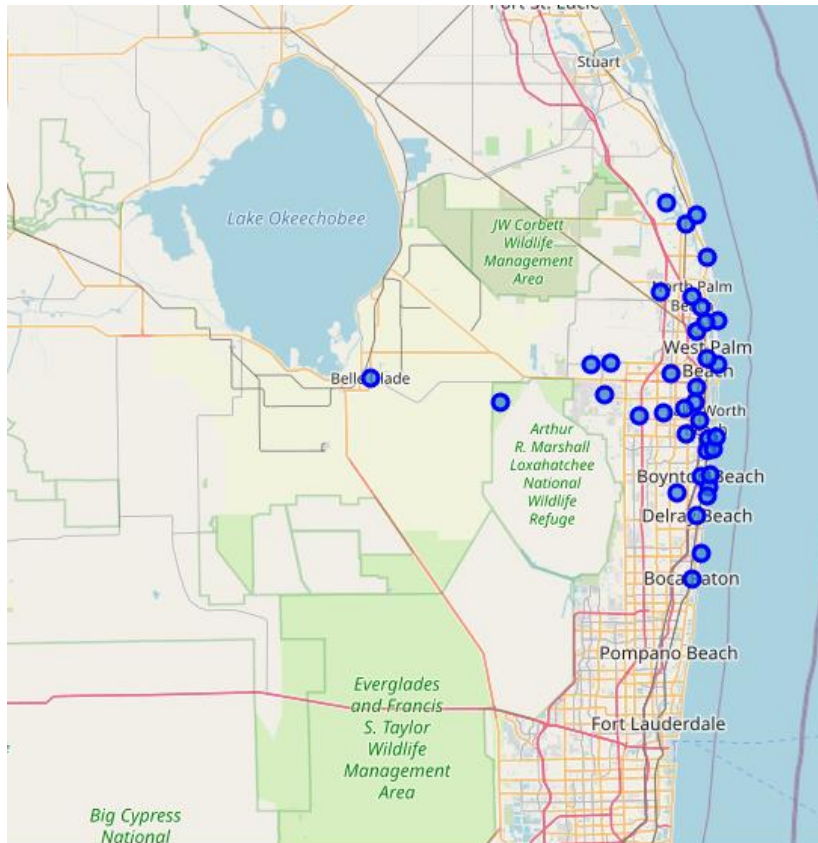


Figure 3. Palm Beach County Neighborhoods Map with each municipality identified by a blue dot

FOURSQUARE API

I called the FOURSQUARE API to retrieve up to 100 venues with a radius of one and a half miles of the latitude and longitude of each neighborhood. The radius was calculated as the average square mile area of all municipalities. The API retrieved 248 unique venue categories. The first five rows of the retrieved data:

| | Neighborhoods | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|---|---------------|-----------------------|------------------------|------------------------------|----------------|-----------------|---------------------------------|
| 0 | Belle Glade | 26.68451 | -80.667558 | Walgreens | 26.686691 | -80.667077 | Pharmacy |
| 1 | Belle Glade | 26.68451 | -80.667558 | Banyan Tree | 26.697297 | -80.683464 | Southern / Soul Food Restaurant |
| 2 | Belle Glade | 26.68451 | -80.667558 | CVS Pharmacy | 26.685225 | -80.667529 | Pharmacy |
| 3 | Belle Glade | 26.68451 | -80.667558 | Wells Fargo Drive-Up Bank | 26.685185 | -80.668703 | Bank |
| 4 | Belle Glade | 26.68451 | -80.667558 | United States Postal Service | 26.696251 | -80.680954 | Post Office |

Figure 4. pandas DataFrame of neighborhood venues retrieved by FOURSQUARE API (first 5 rows)

Most of the municipalities reached the 100 venue limit or came close to it, but a quarter of them did not. Those that did not are at the lower end in terms of population density. One municipality; however, Atlantis, did not return any venues. Those municipalities at 26 venues or below included Belle Glade, Pahokee, Palm Beach, South Bay, and Tequesta. Eleven municipalities had between 50 and 75 venues; they are Highland Beach, Hypoluxo, Juno Beach, Jupiter Inlet Colony, Lake Park, Loxahatchee Groves, Manalapan, Mongonia Park, Palm Beach Gardens, Palm Beach Shores, and

Wellington. The bar chart below, which I created with matplotlib.pyplot, illustrates that those municipalities that returned fewer venues also have mid to lower population densities.

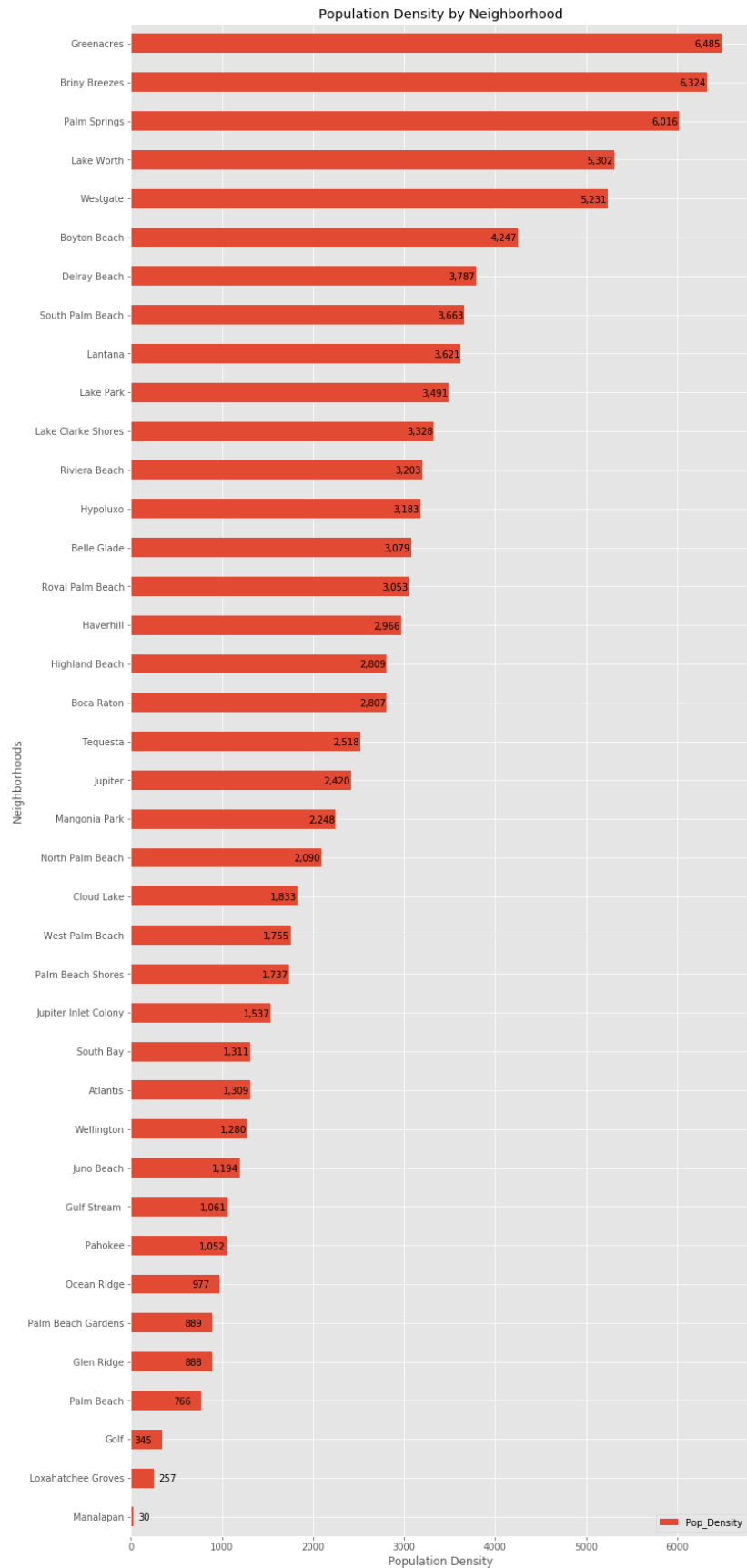


Figure 5. Bar Chart of Population Density for all municipalities in Palm Beach County, FL

The FOURSQUARE API results are dependent upon FOURSQUARE user input at the time the API is run. The pandas DataFrame below shows the ten most common venues for each municipality. At the time the API was run, Florida had recently opened from the lockdown from COVID-19. Palm Beach County was a hot spot in Florida at the time; and therefore, was more restricted in terms of opening businesses. The venues listed reflect this situation as grocery stores, restaurants with takeout, banks, and parks and beaches predominate.

| | Neighborhoods | 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 |
|----|----------------------|-----------------------|-----------------------|---------------------------|---------------------------------|---------------------------|-----------------------|-----------------------|-----------------------|---------------------------|-------------------------|
| 0 | Belle Glade | Fast Food Restaurant | Pharmacy | Fried Chicken Joint | Southern / Soul Food Restaurant | Gas Station | Bank | Park | Theater | Donut Shop | Grocery Store |
| 1 | Boca Raton | Grocery Store | Bar | Sushi Restaurant | Pizza Place | Coffee Shop | Hotel | Bakery | Italian Restaurant | Mexican Restaurant | Asian Restaurant |
| 2 | Boyton Beach | Beach | American Restaurant | Bakery | Seafood Restaurant | Sushi Restaurant | Department Store | Mexican Restaurant | Italian Restaurant | Latin American Restaurant | Burger Joint |
| 3 | Briny Breezes | Beach | American Restaurant | Fast Food Restaurant | Seafood Restaurant | Diner | Pizza Place | Deli / Bodega | Donut Shop | Bank | Park |
| 4 | Cloud Lake | Rental Car Location | American Restaurant | Diner | Donut Shop | Convenience Store | Hotel | Italian Restaurant | Fast Food Restaurant | Grocery Store | Café |
| 5 | Delray Beach | Beach | Italian Restaurant | Grocery Store | Pizza Place | Hotel | American Restaurant | Seafood Restaurant | Coffee Shop | Burger Joint | New American Restaurant |
| 6 | Glen Ridge | Rental Car Location | American Restaurant | Donut Shop | Hotel | Diner | Convenience Store | Café | Pharmacy | Fast Food Restaurant | Sandwich Place |
| 7 | Golf | American Restaurant | Fast Food Restaurant | Pizza Place | Golf Course | Pharmacy | Donut Shop | Bakery | Grocery Store | Sandwich Place | Department Store |
| 8 | Greenacres | Pizza Place | Pharmacy | Discount Store | Convenience Store | Latin American Restaurant | Bank | American Restaurant | Donut Shop | Sandwich Place | Ice Cream Shop |
| 9 | Gulf Stream | Beach | Seafood Restaurant | Hotel | American Restaurant | Pizza Place | Diner | Italian Restaurant | Spa | New American Restaurant | Coffee Shop |
| 10 | Haverhill | Sandwich Place | Pizza Place | Latin American Restaurant | Grocery Store | Pharmacy | American Restaurant | Park | Mobile Phone Shop | Hardware Store | Fast Food Restaurant |
| 11 | Highland Beach | Gym / Fitness Center | Hotel | Grocery Store | Italian Restaurant | Pizza Place | Pharmacy | Shipping Store | Brewery | Park | Pub |
| 12 | Hypoluxo | Harbor / Marina | Beach | Donut Shop | Sushi Restaurant | Brewery | Grocery Store | American Restaurant | Pizza Place | Seafood Restaurant | Breakfast Spot |
| 13 | Juno Beach | Beach | Seafood Restaurant | Park | Thai Restaurant | Café | Harbor / Marina | Board Shop | Pharmacy | American Restaurant | Resort |
| 14 | Jupiter | Sandwich Place | Pizza Place | Italian Restaurant | Breakfast Spot | Donut Shop | Fast Food Restaurant | Grocery Store | Ice Cream Shop | Mexican Restaurant | Convenience Store |
| 15 | Jupiter Inlet Colony | Beach | Seafood Restaurant | Coffee Shop | Convenience Store | Italian Restaurant | Grocery Store | Ice Cream Shop | Thai Restaurant | Bank | Fast Food Restaurant |
| 16 | Lake Clarke Shores | Pizza Place | Discount Store | Bank | Pharmacy | American Restaurant | Donut Shop | Convenience Store | Bar | Cuban Restaurant | Fast Food Restaurant |
| 17 | Lake Park | American Restaurant | Harbor / Marina | Park | Pizza Place | Beach | Coffee Shop | Seafood Restaurant | Grocery Store | Convenience Store | Sandwich Place |

| | | | | | | | | | | | |
|----|--------------------|----------------------|----------------------|----------------------|-------------------------|--------------------|----------------------|----------------------------|----------------------|---------------------|---------------------------|
| 18 | Lake Worth | Grocery Store | American Restaurant | Pizza Place | Seafood Restaurant | Coffee Shop | Convenience Store | Golf Course | Bank | Donut Shop | Hotel |
| 19 | Lantana | Pizza Place | Discount Store | Seafood Restaurant | Harbor / Marina | Grocery Store | Fast Food Restaurant | American Restaurant | Hotel | Gas Station | Pharmacy |
| 20 | Loxahatchee Groves | Grocery Store | Bank | Fast Food Restaurant | Pizza Place | Pharmacy | Sandwich Place | Construction & Landscaping | Gas Station | Convenience Store | Donut Shop |
| 21 | Manalapan | Pizza Place | Harbor / Marina | Gas Station | Hotel | Grocery Store | American Restaurant | Fast Food Restaurant | Brewery | Discount Store | Beach |
| 22 | Mangonia Park | Fast Food Restaurant | Hotel | Sandwich Place | Convenience Store | Pharmacy | Fried Chicken Joint | Harbor / Marina | Bank | Discount Store | American Restaurant |
| 23 | North Palm Beach | American Restaurant | Pizza Place | Seafood Restaurant | Sandwich Place | Grocery Store | Italian Restaurant | Breakfast Spot | Pharmacy | Spa | Café |
| 24 | Ocean Ridge | Beach | Fast Food Restaurant | American Restaurant | Bank | Seafood Restaurant | Harbor / Marina | Pizza Place | Convenience Store | Donut Shop | Park |
| 25 | Pahokee | Home Service | Convenience Store | Park | Bank | Lake | Grocery Store | American Restaurant | Discount Store | Diner | French Restaurant |
| 26 | Palm Beach | Business Service | Zoo | Fast Food Restaurant | Fruit & Vegetable Store | Frozen Yogurt Shop | Fried Chicken Joint | French Restaurant | Food Truck | Food Service | Food & Drink Shop |
| 27 | Palm Beach Gardens | Golf Course | Steakhouse | Mexican Restaurant | Health Food Store | Restaurant | Japanese Restaurant | Coffee Shop | Grocery Store | Seafood Restaurant | Pharmacy |
| 28 | Palm Beach Shores | Seafood Restaurant | Beach | Grocery Store | Pool | Café | Park | Harbor / Marina | American Restaurant | Donut Shop | Resort |
| 29 | Palm Springs | Convenience Store | Bank | Sandwich Place | Donut Shop | Discount Store | Pizza Place | Pharmacy | Grocery Store | American Restaurant | Latin American Restaurant |
| 30 | Riviera Beach | Grocery Store | American Restaurant | Convenience Store | Fast Food Restaurant | Seafood Restaurant | Fried Chicken Joint | Discount Store | Pharmacy | Donut Shop | Pizza Place |
| 31 | Royal Palm Beach | Bank | Department Store | Pizza Place | Coffee Shop | Golf Course | American Restaurant | Grocery Store | Fast Food Restaurant | Pharmacy | Ice Cream Shop |
| 32 | South Bay | Park | Business Service | Theater | Mexican Restaurant | Trail | Snack Place | Harbor / Marina | Lake | Gas Station | Sandwich Place |
| 33 | South Palm Beach | Hotel | Pizza Place | American Restaurant | Discount Store | Grocery Store | Seafood Restaurant | Gas Station | Sandwich Place | Restaurant | Pharmacy |
| 34 | Tequesta | Golf Course | Campground | River | Baseball Field | Trail | Home Service | Science Museum | Church | Park | Dive Bar |
| 35 | Wellington | Stadium | Grocery Store | Bank | Pizza Place | Restaurant | Gas Station | Shipping Store | Golf Course | Asian Restaurant | Sandwich Place |
| 36 | West Palm Beach | Italian Restaurant | French Restaurant | American Restaurant | Bar | Restaurant | Asian Restaurant | Gastropub | Ice Cream Shop | Steakhouse | Mediterranean Restaurant |
| 37 | Westgate | American Restaurant | Sandwich Place | Discount Store | Pizza Place | Mexican Restaurant | Grocery Store | Convenience Store | Coffee Shop | Shopping Mall | Latin American Restaurant |

Figure 6. pandas DataFrame of top ten venues retrieve from FOURSQUARE API for municipalities

K Nearest Neighbor

I chose sklearn.cluster.KMeans in the scikit-learn library to perform a K Nearest Neighbor unsupervised algorithm to cluster neighborhoods based upon their shared top venue types. First, I found the best k by executing KMeans from 2 to 10 values for k, calculated the squared error and graphed the result. The best value for k is 3 as indicated by the first 'elbow' on the graph.

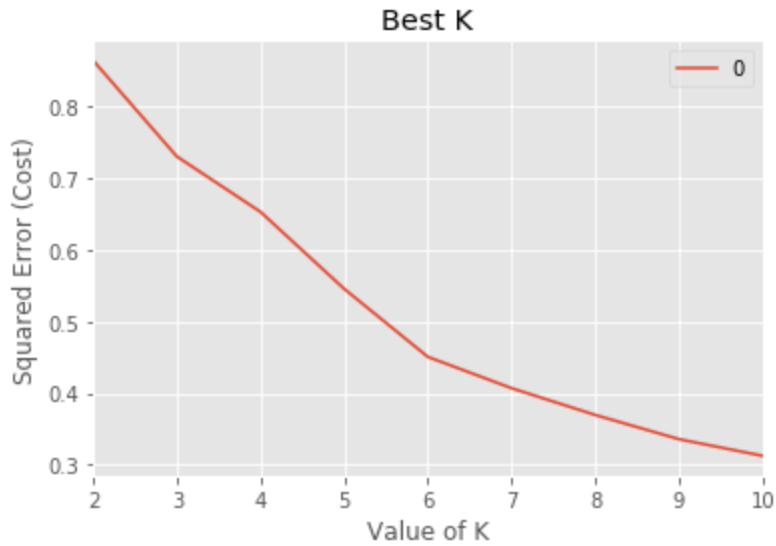


Figure 7. Graph indicating best K as 3

I then ran KMeans again with k set to 3 to produce Cluster Labels for each neighborhood. The resulting three clusters can be characterized by their main venues. The clusters are visualized with the following Folium map.

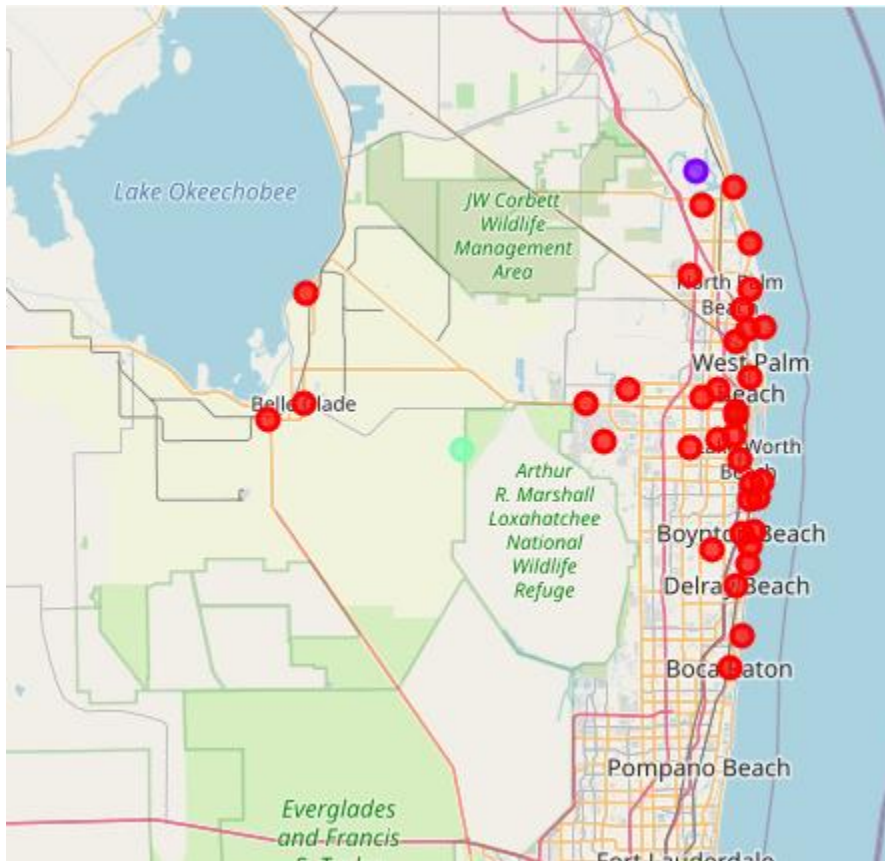


Figure 8. Cluster Map: Cluster 0 in red, Cluster 1 in purple, Cluster 3 in green

By examining the top ten venues in each cluster, I defined them as follows:

CLUSTER 0 - Residential - with a variety of restaurants and other eateries

| | Neighborhood | Pop_Density | 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 |
|----|----------------------|-------------|----------------|-----------------------|-----------------------|---------------------------|---------------------------------|---------------------------|-----------------------|----------------------------|-----------------------|---------------------------|
| 1 | Belle Glade | 3079.62 | 0.0 | Fast Food Restaurant | Pharmacy | Fried Chicken Joint | Southern / Soul Food Restaurant | Gas Station | Bank | Park | Theater | Donut Shop |
| 2 | Boca Raton | 2807.81 | 0.0 | Grocery Store | Bar | Sushi Restaurant | Pizza Place | Coffee Shop | Hotel | Bakery | Italian Restaurant | Mexican Restaurant |
| 3 | Boyton Beach | 4247.63 | 0.0 | Beach | American Restaurant | Bakery | Seafood Restaurant | Sushi Restaurant | Department Store | Mexican Restaurant | Italian Restaurant | Latin American Restaurant |
| 4 | Briny Breezes | 6324.32 | 0.0 | Beach | American Restaurant | Fast Food Restaurant | Seafood Restaurant | Diner | Pizza Place | Deli / Bodega | Donut Shop | Bank |
| 5 | Cloud Lake | 1833.33 | 0.0 | Rental Car Location | American Restaurant | Diner | Donut Shop | Convenience Store | Hotel | Italian Restaurant | Fast Food Restaurant | Grocery Store |
| 6 | Delray Beach | 3787.64 | 0.0 | Beach | Italian Restaurant | Grocery Store | Pizza Place | Hotel | American Restaurant | Seafood Restaurant | Coffee Shop | Burger Joint |
| 7 | Glen Ridge | 888.37 | 0.0 | Rental Car Location | American Restaurant | Donut Shop | Hotel | Diner | Convenience Store | Café | Pharmacy | Fast Food Restaurant |
| 8 | Golf | 345.60 | 0.0 | American Restaurant | Fast Food Restaurant | Pizza Place | Golf Course | Pharmacy | Donut Shop | Bakery | Grocery Store | Sandwich Place |
| 9 | Greenacres | 6485.85 | 0.0 | Pizza Place | Pharmacy | Discount Store | Convenience Store | Latin American Restaurant | Bank | American Restaurant | Donut Shop | Sandwich Place |
| 10 | Gulf Stream | 1061.81 | 0.0 | Beach | Seafood Restaurant | Hotel | American Restaurant | Pizza Place | Diner | Italian Restaurant | Spa | New American Restaurant |
| 11 | Haverhill | 2966.98 | 0.0 | Sandwich Place | Pizza Place | Latin American Restaurant | Grocery Store | Pharmacy | American Restaurant | Park | Mobile Phone Shop | Hardware Store |
| 12 | Highland Beach | 2809.41 | 0.0 | Gym / Fitness Center | Hotel | Grocery Store | Italian Restaurant | Pizza Place | Pharmacy | Shipping Store | Brewery | Park |
| 13 | Hypoluxo | 3183.49 | 0.0 | Harbor / Marina | Beach | Donut Shop | Sushi Restaurant | Brewery | Grocery Store | American Restaurant | Pizza Place | Seafood Restaurant |
| 14 | Juno Beach | 1194.57 | 0.0 | Beach | Seafood Restaurant | Park | Thai Restaurant | Café | Harbor / Marina | Board Shop | Pharmacy | American Restaurant |
| 15 | Jupiter | 2420.83 | 0.0 | Sandwich Place | Pizza Place | Italian Restaurant | Breakfast Spot | Donut Shop | Fast Food Restaurant | Grocery Store | Ice Cream Shop | Mexican Restaurant |
| 16 | Jupiter Inlet Colony | 1537.38 | 0.0 | Beach | Seafood Restaurant | Coffee Shop | Convenience Store | Italian Restaurant | Grocery Store | Ice Cream Shop | Thai Restaurant | Bank |
| 17 | Lake Clarke Shores | 3328.78 | 0.0 | Pizza Place | Discount Store | Bank | Pharmacy | American Restaurant | Donut Shop | Convenience Store | Bar | Cuban Restaurant |
| 18 | Lake Park | 3491.06 | 0.0 | American Restaurant | Harbor / Marina | Park | Pizza Place | Beach | Coffee Shop | Seafood Restaurant | Grocery Store | Convenience Store |
| 19 | Lake Worth | 5302.31 | 0.0 | Grocery Store | American Restaurant | Pizza Place | Seafood Restaurant | Coffee Shop | Convenience Store | Golf Course | Bank | Donut Shop |
| 20 | Lantana | 3621.70 | 0.0 | Pizza Place | Discount Store | Seafood Restaurant | Harbor / Marina | Grocery Store | Fast Food Restaurant | American Restaurant | Hotel | Gas Station |
| 21 | Loxahatchee Groves | 257.03 | 0.0 | Grocery Store | Bank | Fast Food Restaurant | Pizza Place | Pharmacy | Sandwich Place | Construction & Landscaping | Gas Station | Convenience Store |
| 22 | Manalapan | 30.14 | 0.0 | Pizza Place | Harbor / Marina | Gas Station | Hotel | Grocery Store | American Restaurant | Fast Food Restaurant | Brewery | Discount Store |
| 23 | Mangonia Park | 2248.99 | 0.0 | Fast Food Restaurant | Hotel | Sandwich Place | Convenience Store | Pharmacy | Fried Chicken Joint | Harbor / Marina | Bank | Discount Store |
| 24 | North Palm Beach | 2090.06 | 0.0 | American Restaurant | Pizza Place | Seafood Restaurant | Sandwich Place | Grocery Store | Italian Restaurant | Breakfast Spot | Pharmacy | Spa |
| 25 | Ocean Ridge | 977.56 | 0.0 | Beach | Fast Food Restaurant | American Restaurant | Bank | Seafood Restaurant | Harbor / Marina | Pizza Place | Convenience Store | Donut Shop |

| | | | | | | | | | | | | |
|----|--------------------|---------|-----|---------------------|---------------------|---------------------|----------------------|--------------------|---------------------|---------------------|----------------------|---------------------|
| 26 | Pahokee | 1052.85 | 0.0 | Home Service | Convenience Store | Park | Bank | Lake | Grocery Store | American Restaurant | Discount Store | Diner |
| 28 | Palm Beach Gardens | 889.08 | 0.0 | Golf Course | Steakhouse | Mexican Restaurant | Health Food Store | Restaurant | Japanese Restaurant | Coffee Shop | Grocery Store | Seafood Restaurant |
| 29 | Palm Beach Shores | 1737.67 | 0.0 | Seafood Restaurant | Beach | Grocery Store | Pool | Café | Park | Harbor / Marina | American Restaurant | Donut Shop |
| 30 | Palm Springs | 6016.14 | 0.0 | Convenience Store | Bank | Sandwich Place | Donut Shop | Discount Store | Pizza Place | Pharmacy | Grocery Store | American Restaurant |
| 31 | Riviera Beach | 3203.70 | 0.0 | Grocery Store | American Restaurant | Convenience Store | Fast Food Restaurant | Seafood Restaurant | Fried Chicken Joint | Discount Store | Pharmacy | Donut Shop |
| 32 | Royal Palm Beach | 3053.39 | 0.0 | Bank | Department Store | Pizza Place | Coffee Shop | Golf Course | American Restaurant | Grocery Store | Fast Food Restaurant | Pharmacy |
| 33 | South Bay | 1311.45 | 0.0 | Park | Business Service | Theater | Mexican Restaurant | Trail | Snack Place | Harbor / Marina | Lake | Gas Station |
| 34 | South Palm Beach | 3663.19 | 0.0 | Hotel | Pizza Place | American Restaurant | Discount Store | Grocery Store | Seafood Restaurant | Gas Station | Sandwich Place | Restaurant |
| 36 | Wellington | 1280.07 | 0.0 | Stadium | Grocery Store | Bank | Pizza Place | Restaurant | Gas Station | Shipping Store | Golf Course | Asian Restaurant |
| 37 | West Palm Beach | 1755.88 | 0.0 | Italian Restaurant | French Restaurant | American Restaurant | Bar | Restaurant | Asian Restaurant | Gastropub | Ice Cream Shop | Steakhouse |
| 38 | Westgate | 5231.83 | 0.0 | American Restaurant | Sandwich Place | Discount Store | Pizza Place | Mexican Restaurant | Grocery Store | Convenience Store | Coffee Shop | Shopping Mall |

Figure 9. Top nine venues for Cluster 0

CLUSTER 1 - Outdoor leisure activities - golfing, camping, boating - and parks

| | Neighborhood | Pop_Density | 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 |
|----|--------------|-------------|----------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| 35 | Tequesta | 2518.66 | 1.0 | Golf Course | Campground | River | Baseball Field | Trail | Home Service | Science Museum | Church | Park | Dive Bar |

Figure 10. Top ten venues for Cluster 1

CLUSTER 2 - Food and Business

| | Neighborhood | Pop_Density | 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 |
|----|--------------|-------------|----------------|-----------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| 27 | Palm Beach | 766.02 | 2.0 | Business Service | Zoo | Fast Food Restaurant | Fruit & Vegetable Store | Frozen Yogurt Shop | Fried Chicken Joint | French Restaurant | Food Truck | Food Service | Food & Drink Shop |

Figure 11. Top 10 venues for Cluster 2

Histograms and Bar Charts of Median Income, Median Property Values, and Population Density for Neighborhoods in Palm Beach County

I created histograms and bar charts with matplotlib.pyplot to visualize median income, median property values, and population density in Palm Beach County.

Median Income

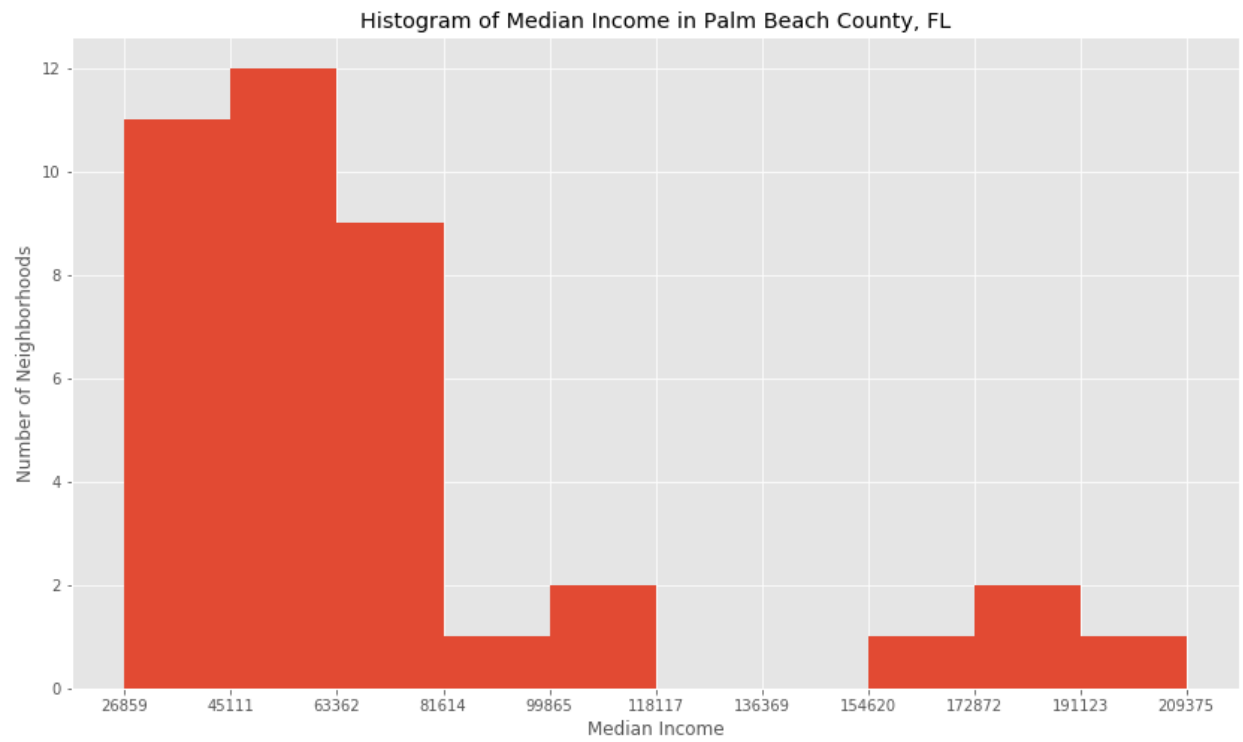


Figure 12. Histogram of Median Income for all municipalities in Palm Beach County

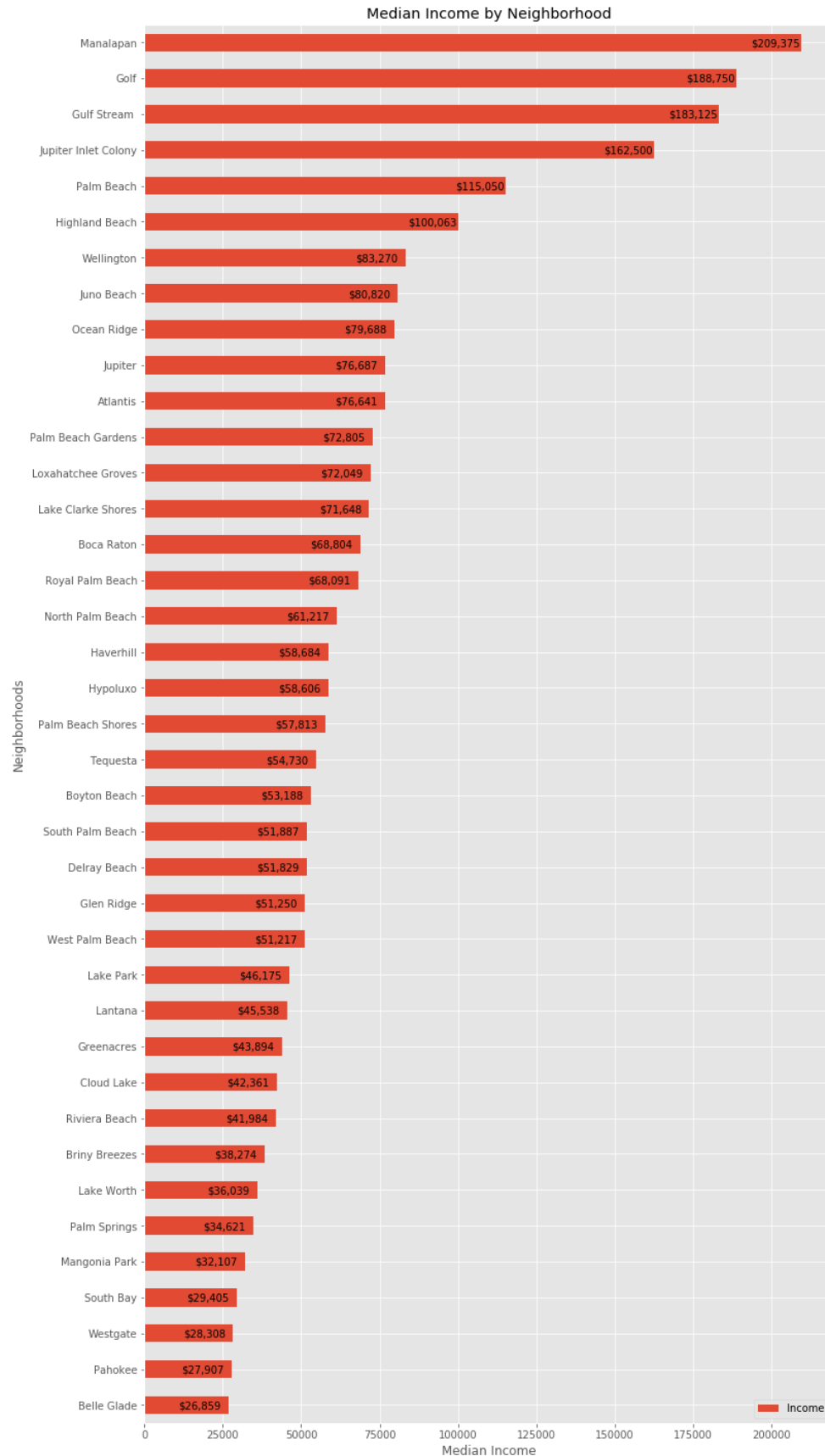


Figure 13. Bar Chart of Median Income for all municipalities in Palm Beach County

Median Property Value

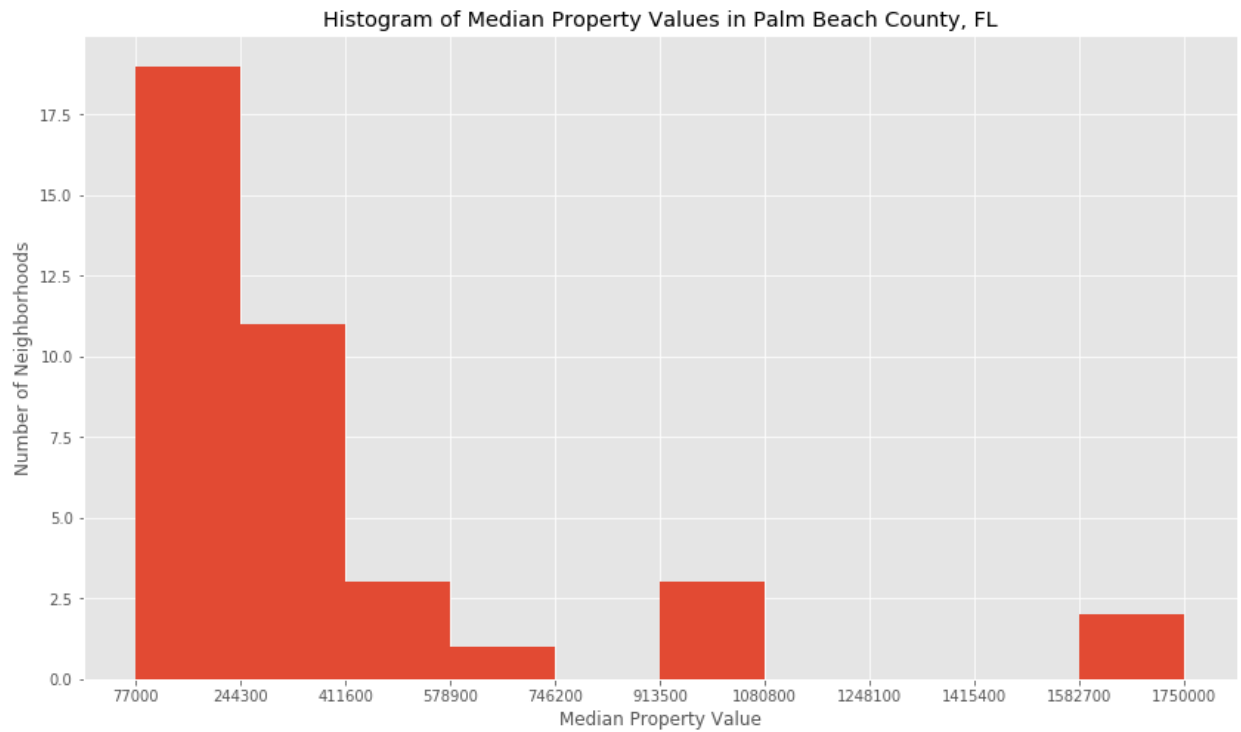


Figure 14. Histogram of Median Property Values for all municipalities in Palm Beach County

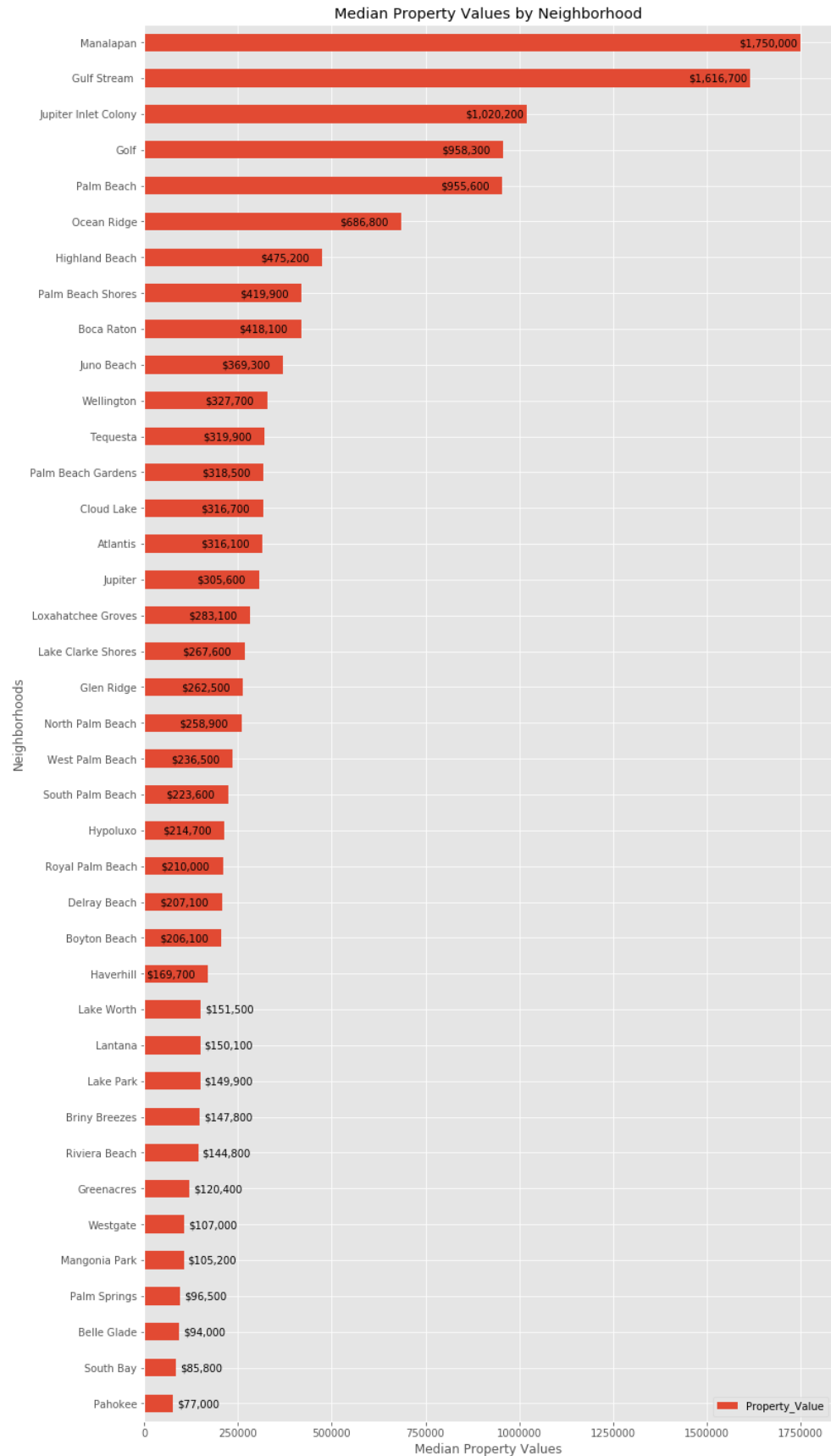


Figure 15. Bar Chart of Median Property Values for all municipalities in Palm Beach County

Population Density

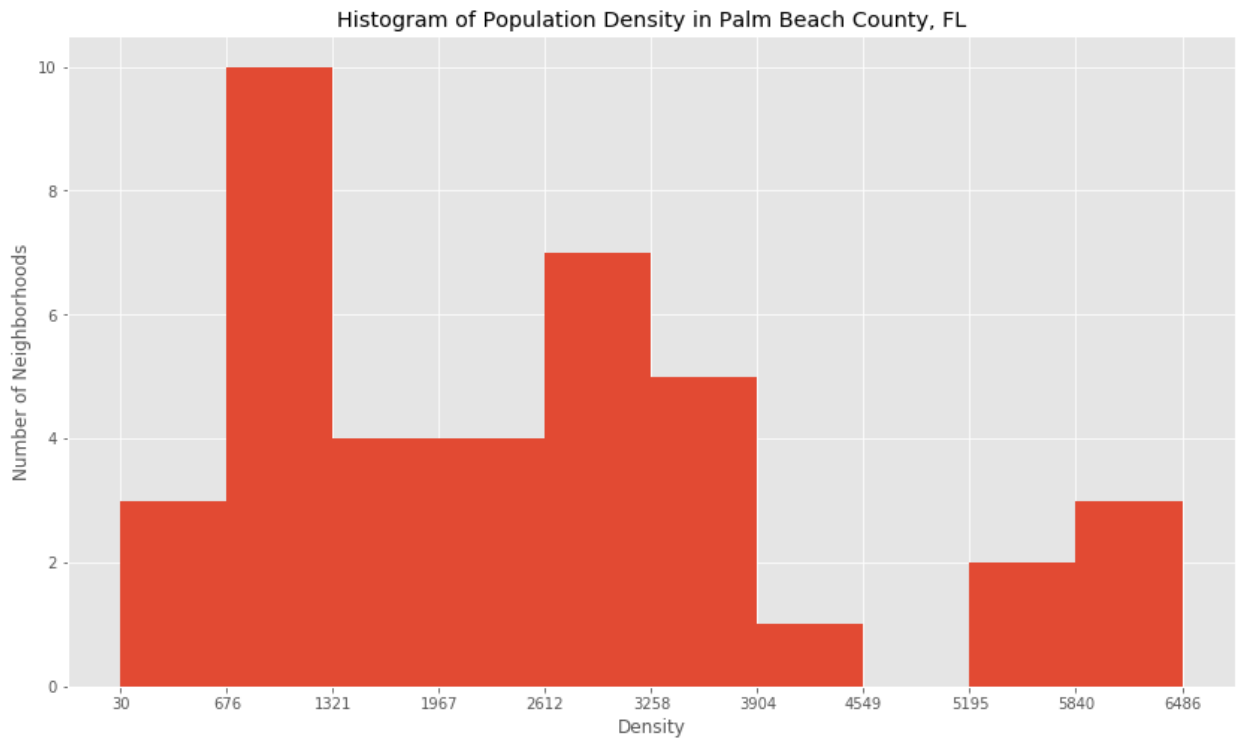


Figure 16. Histogram of Population Density for all municipalities in Palm Beach County

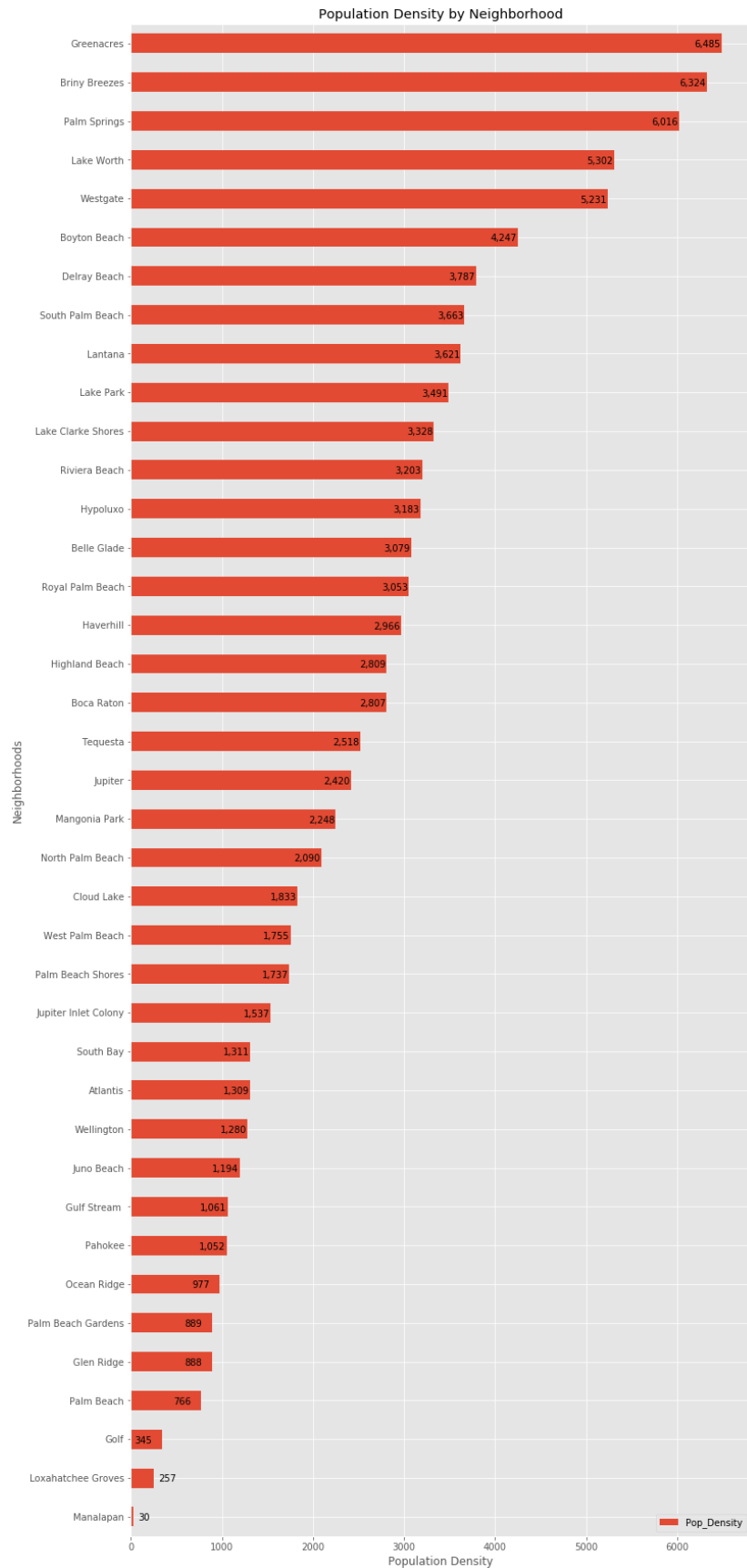


Figure 17. Bar Chart of Population Density for all municipalities in Palm Beach County

Area (square miles)

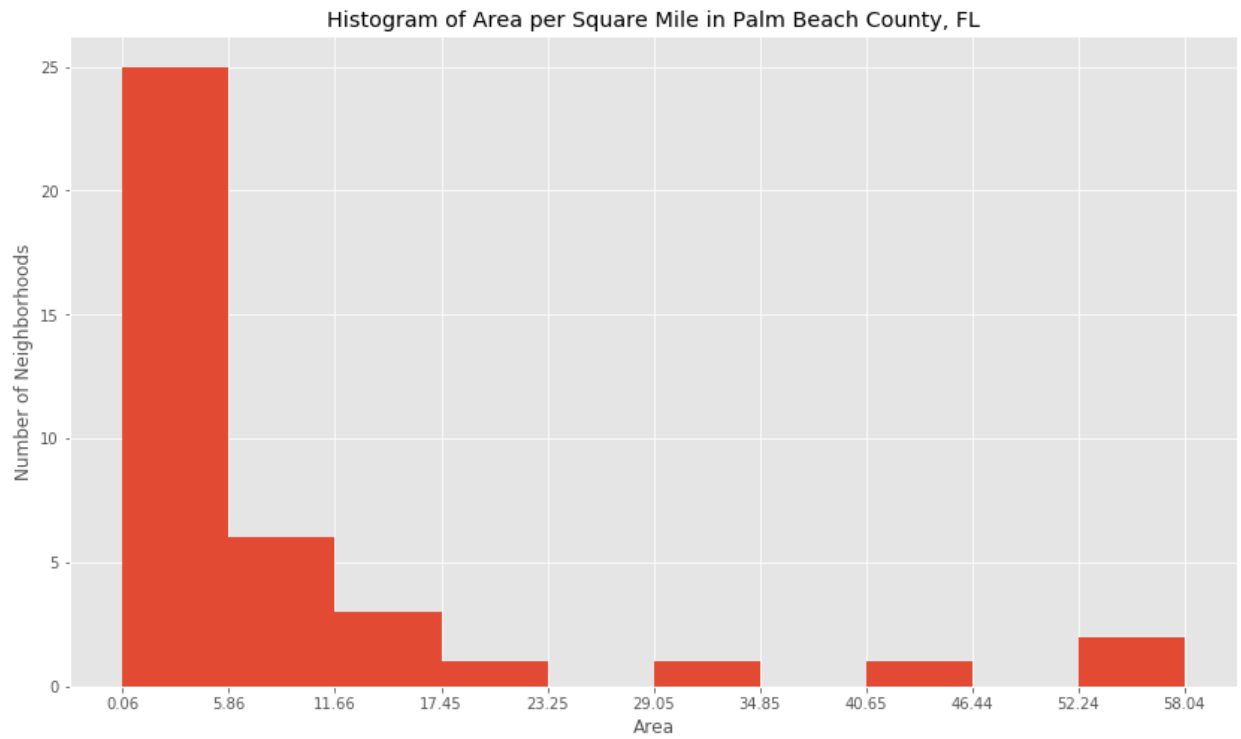


Figure 18. Histogram of Area for all municipalities in Palm Beach County

Area of Municipalities in Square Miles

| Area | Area | Area |
|---------------------------|-----------------------|--------------------------|
| Neighborhood | Neighborhood | Neighborhood |
| Cloud Lake 0.06 | Atlantis 1.44 | Lake Worth 6.66 |
| Briny Breezes 0.11 | Westgate 1.51 | Riviera Beach 10.25 |
| Jupiter Inlet Colony 0.21 | Ocean Ridge 1.78 | Manalapan 10.52 |
| Glen Ridge 0.22 | Tequesta 2.25 | Palm Beach 11.10 |
| South Palm Beach 0.29 | Lake Park 2.35 | Royal Palm Beach 11.35 |
| Palm Beach Shores 0.51 | Juno Beach 2.69 | Loxahatchee Groves 12.45 |
| Haverhill 0.64 | Lantana 2.88 | Delray Beach 16.25 |
| Mangonia Park 0.74 | Palm Springs 3.35 | Boyton Beach 16.51 |
| Hypoluxo 0.81 | South Bay 3.70 | Jupiter 23.25 |
| Gulf Stream 0.83 | Pahokee 5.54 | Boca Raton 31.29 |
| Golf 0.84 | Belle Glade 5.71 | Wellington 45.09 |
| Lake Clarke Shores 1.03 | North Palm Beach 5.80 | Palm Beach Gardens 55.34 |
| Highland Beach 1.28 | Greenacres 5.87 | West Palm Beach 58.04 |

Figure 19. Neighborhoods and their Area (sq mi) color coded

Results

KMeans

The best value for K is 3 according to the calculation of cost or squared error when plotted.

Cluster 0 includes 36 neighborhoods which includes all neighborhoods except for the two that are in Clusters 1 and 2. I characterized this cluster as residential. It is made up of a wide variety of restaurants and other eateries as well as grocery stores, banks and beaches.

Cluster 1 includes only the municipality of Tequesta. I called this cluster outdoor leisure activities because the most common venues are golfing, camping, boating, and baseball. Also included are science museum, church, and parks.

Cluster 2 includes only the municipality of Palm Beach. I characterized this cluster as business and food. The top venues are business services, zoo, and eateries.

Venues were not retrieved for the municipality of Atlantis; and therefore, was not included in a cluster.

Histograms and Bar Charts

Median Income

The histogram of Median Income shows three groups.

The group with the most neighborhoods, 32 neighborhoods, has the lowest median income level of about 27,000 USD to 81,000 USD.

The remaining neighborhoods are split between medium and high median income levels. The group with medium median income levels includes only 3 neighborhoods (Wellington (about 83,000 USD), Highland Beach (about 100,000 USD), and Palm Beach (about 115,000 USD)).

And the third group with the highest median income includes 4 neighborhoods (Jupiter Inlet Colony (about 163,000 USD), Gulf Stream (about 183,000 USD), Golf (about 189,000 USD), and Manalapan (about 209,000 USD)).

Median Property Values

The histogram of Median Property Values shows four groups.

The group with the most neighborhoods, 28 neighborhoods, has the lowest median property values which range from 77,000 USD to 370,000 USD.

The second group of 4 neighborhoods – Boca Raton, Palm Beach Shores, Highland Beach, and Ocean Ridge – have median property values between 418,000 USD and \$687,000 USD.

The third group comprising 3 neighborhoods – Palm Beach, Golf, and Jupiter Inlet – have median property values from about 956,000 to about 1.1 million USD.

And the fourth group of 2 neighborhoods – Gulf Stream and Manalapan - have median property values over 1.6 million USD.

Population Density

The histogram of Population Density shows three groups.

The three neighborhoods with the lowest population density are Manalapan, Loxahatchee Groves, and Golf.

Most neighborhoods fall within the medium density range, and the neighborhoods with the highest population density are Westgate, Lake Worth, Palm Springs, Briny Breezes, and Greenacres.

Area

The histogram of Area shows there are four major neighborhoods in terms of square mile area. The first group includes most neighborhoods, 35. These neighborhoods are blue in the table, Area of Municipalities in Square Miles, Figure 19. Most of these neighborhoods are very small; 25 neighborhoods are under 6 square miles while the other small neighborhoods are under about 23 square miles.

One neighborhood, Boca Raton, is of medium size or about 31 square miles. It is turquoise in the Municipalities in Square Miles, Figure 19 table.

Wellington is larger, at about 45 square miles, and colored purple in the Municipalities in Square Miles, Figure 19 table.

The two largest municipalities are Palm Beach Gardens and West Palm Beach at about 55 square miles and 58 square miles, respectively. They are colored in yellow in the Municipalities in Square Miles, Figure 19 table.

Discussion

Palm Beach County is diverse in terms of income levels, and property values. Palm Beach County median income ranges from below the national average of 57,617 USD to well above it. Similarly, Palm Beach County median property values ranges from below the national average of 205,000 USD to well above it. As a result, Palm Beach County offers home affordability for all income levels.

Most municipalities are relatively small in terms of area in square miles. And, most of Palm Beach County has a higher population density than the national average of 92.9 residents per square mile of land area.

According to K Means, Palm Beach County can be segregated into three main clusters. Two of these clusters have only one municipality (Tequesta, and Palm Beach), and the third cluster has the rest of the municipalities.

Tequesta (Cluster 0) is the northernmost municipality in Palm Beach County, situated between the Atlantic Ocean and the Loxahatchee River, with an active recreational department, lots of golf courses, and many campgrounds.

Palm Beach (Cluster 1) is an island centrally located in Palm Beach County with the Atlantic Ocean to the east and the Intracoastal Waterway to the west. It is just across the waterway to West Palm Beach; and as such, the venues cited are more related to West Palm Beach than Palm Beach. For example, zoo is the second most common venue, but there is not a zoo on Palm Beach; rather, it is in West Palm Beach. In addition, fast food restaurants, the third most common venue are also not found on Palm Beach. Palm Beach is mostly residential and home to the wealthy and upscale dining and shopping. Notable examples are Mar-a-Lago and Worth Avenue.

The third cluster (Cluster 2) groups municipalities that are inland with those that are on the coast. Inland municipalities are mainly residential whereas coastline municipalities, while also residential, contribute to Florida's tourism economy with their beaches and hotels. The most popular venues in this cluster are restaurants, grocery stores, and banks.

The clustering is skewed by COVID-19. Although Florida was one of the first states to open from the lockdown, people mainly patronize grocery stores, and banks as well as restaurants and other eateries, and the beach. The tourist industry in Florida has greatly suffered as people are not traveling in general, and specifically to Florida. Once the economy has recovered, the K Means clustering should be more representative of Palm Beach County municipalities.

Conclusion

This project is meant to give active seniors who plan to relocate an overview of Palm Beach County, Florida information that will help them determine which areas they should explore. The data shows that Palm Beach County allows affordability to a wide range of incomes and desired property values. According to K Means, the county is fairly homogeneous in terms of the most common venues which center around grocery stores, restaurants, banks, and beaches. Because of COVID-19, I believe the data is skewed. Although the state has opened, people are not yet shopping, and taking part in activities as they were before the onset of the pandemic. Also, the tourist industry has suffered greatly since people are not traveling. Once life gets back to normal, the clustering data will be more helpful.

References

Coursera, IBM Professional Data Science Certificate, Course 9, Applied Data Science Capstone, <https://www.coursera.org/learn/applied-data-science-capstone/home/welcome>

FOURSQUARE API <https://api.foursquare.com/v2/venues/explore>

Homefacts website <https://www.homefacts.com/demographics/Florida/Palm-Beach-County.html>
The data for each municipality was retrieved by following the links for each municipality where *Palm-Beach-County* was replaced with municipality name. For example, to obtain data for the municipality *Atlantis*, the URL becomes <https://www.homefacts.com/demographics/Florida/Palm-Beach-County/Atlantis.html>

Palm Beach County logo, <http://discover.pbcgov.org/Pages/default.aspx>

Palm Beach County photo, Wikipedia, https://en.wikipedia.org/wiki/West_Palm_Beach,_Florida