# Comparison Between Two Metropolitan Cities, Istanbul and New York City-A Deeper Look Into Demographics and Cultural Facilities

Murat Hacıoğlu

March 4, 2020

## 1. INTRODUCTION

The main focus of this project is to identify the similarities and dissimilarities from two different aspects between the two metropolitan cities, Istanbul and New York City.

The aspects that will be stressed in this project are variety of cultural facilities, how they are scattered across each city and the distribution of the population.

To begin with, data will be collected and processed to be used for the subsequent analysis. Once the road is paved, several maps will be generated to visualize the density of population and cultural facilities. Folium library will be invoked to create maps and choropleth map will be utilized to achieve these tasks. K-means clustering method will also be called to reinforce the analysis. By combining these data, it is expected to draw a picture for each city. Upon completion of analysis separately for each city, the findings will be compared and discussed to reach a conclusion.

The idea behind the preparation of this project is to emphasize the strong and weak points of these two metropolitan cities as to the variety of cultural facilities in relation with the distribution of population. The municipal officials of the cities , which are subjects of this project, seeking to contribute to the cultural development of their cities may take advantage of this study; the question "What type of cultural facility should be built where" will have been satisfactorily answered at the end.

After setting the goal, it is time to collect the required data which will be refined into a script telling a story of these two great cities.

## 2. DATA

### 2.1. Data Sources

The types of data that are dealt with for this project are as follows:

- Amount and type of cultural facilities in each neighborhood, and their distribution across boroughs.
- Population data

The data will be obtained from several sources as follows:

- http://www.tuik.gov.tr/ :Demographics of İstanbul .
- https://data.cityofnewyork.us/ :Demographics of New York City.
- Foursquare API: Cultural facilities and Educational institutions
- Google API: Longitude and Latitude İnformation
- http://postakodu.ptt.gov.tr/ :the information here to be used to assign address for each borough in Istanbul to attain latitude and longitude values using google API, as the data are not readily available for İstanbul.
- https://cocl.us/new_york_dataset & https://geo.nyu.edu/catalog/nyu_2451_34572: New York City json data

## 2.2. Data Collection and Cleaning

### 2.2.1. Amount and type of cultural facilities

As stated before, geographic information for New York city is ready to be used whereas the geographic data for Istanbul's Boroughs are not readily available. Therefore, it has been decided to use google API to retrieve longitude and latitude values for each borough in Istanbul in order to use them for further analysis. The data will be processed so that all the necessary information is gathered in one table.

After having all the geographic information, Foursquare API will be utilized to generate the table reflecting the cultural venues in İstanbul.

#### 2.2.1.1. Cultural Facilities in İstanbul

Data collection can sometimes be tricky given the fact that there is not always a direct way to acquire data in a desired format. In this case, postal code for each borough is obtained from the official website of Turkish Post Office. As can be seen in the table below, a panda data frame has been generated by wrangling the data scraped from web.

| | City | Borough | Neighbourhood | Postalcode |
|---|---|---|---|---|
| 0 | İSTANBUL | ADALAR | BURGAZADA MAH | 34975 |
| 1 | İSTANBUL | ADALAR | MADEN MAH | 34970 |
| 2 | İSTANBUL | ADALAR | NİZAM MAH | 34970 |
| 3 | İSTANBUL | ADALAR | HEYBELİADA MAH | 34973 |
| 4 | İSTANBUL | ADALAR | KINALIADA MAH | 34977 |

TABLE 2.1-POSTALCODES OF ISTANBUL'S NEIGHBORHOODS

After this point, Google API becomes involved to pull latitude and longitude information for each neighborhood. By performing a series of API calls, geographic information is inserted into the data frame (see the table below).

| | City | Borough | Neighborhood | Postalcode | Latitude | Longitude |
|---|---|---|---|---|---|---|
| 0 | İSTANBUL | ADALAR | BURGAZADA MAH | 34975 | 40.880000 | 29.066944 |
| 1 | İSTANBUL | ADALAR | MADEN MAH | 34970 | 40.858320 | 29.123072 |
| 2 | İSTANBUL | ADALAR | NİZAM MAH | 34970 | 40.865325 | 29.118710 |
| 3 | İSTANBUL | ADALAR | HEYBELİADA MAH | 34973 | 40.873336 | 29.089627 |
| 4 | İSTANBUL | ADALAR | KINALIADA MAH | 34977 | 40.907748 | 29.048902 |

TABLE 2.2-GEOGRAPHIC DATA OF ISTANBUL'S NEIGHBORHOODS

Next step is to call Foursquare API to attain the cultural venues of following categories:

- Art Gallery
- Concert Hall
- Exhibition Area
- Historical Place
- Monumental Area
- Cinema
- Museum
- Music Venues
- Performance Art Venues

After performing several operations on the raw data provided by Foursquare, the generation of the data frame which will be used for further analysis is complete (see the table below).

| | id | category name | name | latitude | longitude | neighbourhood | borough | catnum |
|---|---|---|---|---|---|---|---|---|
| 0 | 507c8c4091d498d9fc8c67a9 | Public Art | Kuaför Ali Ufuk Çimen | 40.880440 | 29.068968 | BURGAZADA MAH | ADALAR | 0 |
| 1 | 4bf58dd8d48988d1e5931735 | Music Venue | ASSK Disco | 40.879128 | 29.072280 | BURGAZADA MAH | ADALAR | 1 |
| 2 | 4bf58dd8d48988d1e2931735 | Art Gallery | İpek Burgazada | 40.880896 | 29.069002 | BURGAZADA MAH | ADALAR | 2 |
| 3 | 4deefb944765f83613cdba6e | Historic Site | Gönül Bağım | 40.880823 | 29.069742 | BURGAZADA MAH | ADALAR | 3 |
| 4 | 4bf58dd8d48988d1e5931735 | Music Venue | Büyükada Lunapark Restaurant | 40.857445 | 29.120468 | MADEN MAH | ADALAR | 1 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 9915 | 4bf58dd8d48988d17f941735 | Movie Theater | Tek Stüdyoları | 41.025979 | 28.919835 | MALTEPE MAH | ZEYTİNBURNU | 5 |
| 9916 | 4deefb944765f83613cdba6e | Historic Site | Bayrampasa Merkez Camii | 41.035254 | 28.911442 | MALTEPE MAH | ZEYTİNBURNU | 3 |
| 9917 | 4bf58dd8d48988d1e2931735 | Art Gallery | Www.iamistanbul.tv | 41.027397 | 28.911913 | MALTEPE MAH | ZEYTİNBURNU | 2 |
| 9918 | 4bf58dd8d48988d1e2931735 | Art Gallery | Enes Ofset Ajans Reklam | 41.023961 | 28.919067 | MALTEPE MAH | ZEYTİNBURNU | 2 |
| 9919 | 4bf58dd8d48988d17f941735 | Movie Theater | Jimmy Jib Başında | 41.026245 | 28.919827 | MALTEPE MAH | ZEYTİNBURNU | 5 |

TABLE 2.3-CULTURAL VENUES IN ISTANBUL'S NEIGHBORHOODS

Total 9920 cultural venues have been returned by Foursquare for Istanbul.

A map has been generated to provide a visual of how these venues are scattered across the city.

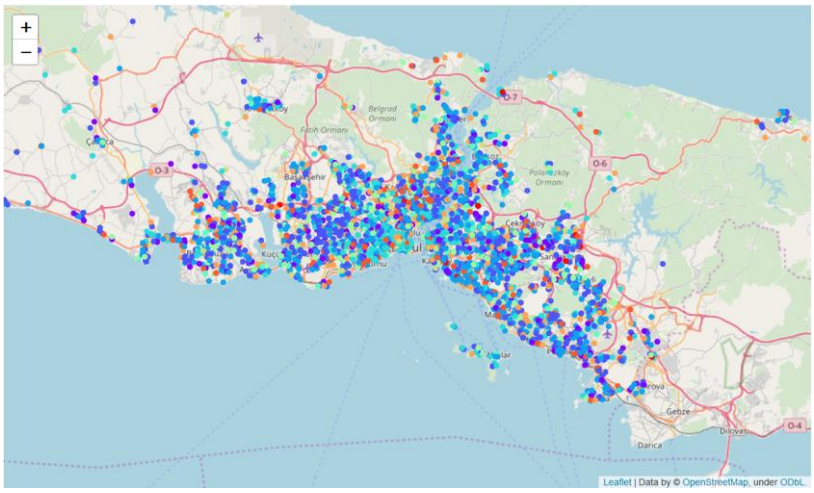



FIGURE 2.1-CULTURAL VENUE DISTRIBUTION IN ISTANBUL

### 2.2.1.2. Cultural Facilities in New York City

Json data are available for New York City; geographic information is pulled from the json file to create the table below.

| | Borough | Neighborhood | Latitude | Longitude |
|---|---|---|---|---|
| 0 | Bronx | Wakefield | 40.894705 | -73.847201 |
| 1 | Bronx | Co-op City | 40.874294 | -73.829939 |
| 2 | Bronx | Eastchester | 40.887556 | -73.827806 |
| 3 | Bronx | Fieldston | 40.895437 | -73.905643 |
| 4 | Bronx | Riverdale | 40.890834 | -73.912585 |

TABLE 2.4-GEOGRAPHIC DATA OF NEW YORK CITY'S NEIGHBORHOODS

Same procedure as applied to İstanbul is followed from this point on. The query for the same categories is run by invoking Foursquare API. By wrangling the data, the following data frame is obtained.

| | id | category name | name | latitude | longitude | neighbourhood | borough | catnum |
|---|---|---|---|---|---|---|---|---|
| 0 | 4bf58dd8d48988d1e5931735 | Music Venue | The Upper Room | 40.892567 | -73.846406 | Wakefield | Bronx | 3 |
| 1 | 4bf58dd8d48988d1e5931735 | Music Venue | Par-City | 40.890211 | -73.847002 | Wakefield | Bronx | 3 |
| 2 | 4bf58dd8d48988d1e2931735 | Art Gallery | Art Gallery Illusion Reality | 40.894949 | -73.856470 | Wakefield | Bronx | 1 |
| 3 | 4bf58dd8d48988d1e5931735 | Music Venue | Matic Records | 40.899774 | -73.857141 | Wakefield | Bronx | 3 |
| 4 | 4bf58dd8d48988d1e5931735 | Music Venue | MY Studio | 40.901926 | -73.853504 | Wakefield | Bronx | 3 |

TABLE 2.5-CULTURAL VENUES OF NEW YORK CITY'S NEIGHBORHOODS

Total 2990 cultural venues have been returned by Foursquare for New York City.

The map shown below illustrates how these venues are scattered across the city.

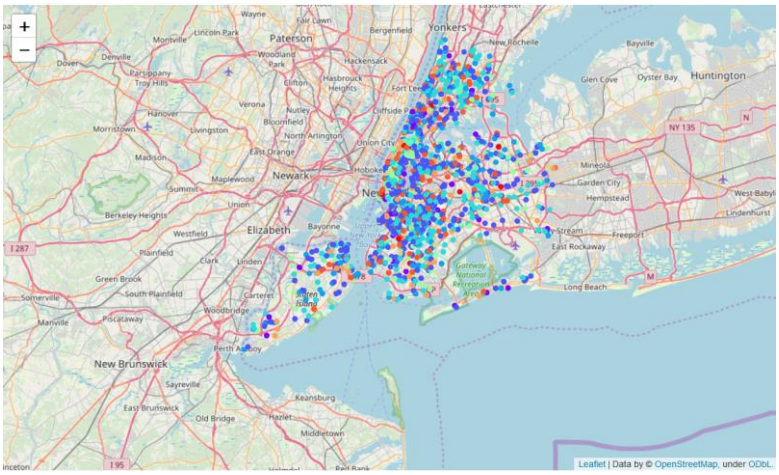



FIGURE 2.2-CULTURAL VENUE DISTRIBUTION IN NEW YORK CITY

### 2.2.2. Population Data

Population data are also the subject of the comparison between NY City and İstanbul for this project. The information will be gathered for each neighbourhood. The data for Istanbul are available on the official website of Turkish Statistical Institute, whereas the website https://data.cityofnewyork.us/ provides demographics of New York City.

#### 2.2.2.1. Population in Istanbul

The population of Istanbul is 15,519,262 according to latest census conducted in 2019. The aim is to generate a data frame showing the breakdown of total population by neighborhood. Raw data has been processed to obtain the following table.

| | Borough | Neighbourhood | Population |
|---|---|---|---|
| 0 | Adalar | Burgazada Mah | 1427 |
| 1 | Adalar | Heybeliada Mah | 4253 |
| 2 | Adalar | Kınalıada Mah | 1758 |
| 3 | Adalar | Maden Mah | 4330 |
| 4 | Adalar | Nizam Mah | 3470 |

TABLE 2.6-POPULATION BREAKDOWN BY NEIGHBORHOOD FOR ISTANBUL

#### 2.2.2.2. Population in New York City

The population of New York City is 8,175,133 according to latest census conducted in 2010. In New York city, population census is conducted every decade. This data may be considered outdated. Even though some projections are available on internet, the expected increase in 10 years is not as much as it can affect the outcome of the analysis performed

in the scope of this project. The aim is to generate a data frame showing the breakdown of total population by neighborhood. Raw data has been processed to obtain the following table.

| | Borough | NTA Code | NTA Name | Population | latitude | longitude |
|---|---|---|---|---|---|---|
| 0 | Bronx | BX01 | Claremont-Bathgate | 31078 | 40.849893 | -73.895474 |
| 1 | Bronx | BX03 | Eastchester-Edenwald-Baychester | 34517 | 40.864322 | -73.843382 |
| 2 | Bronx | BX05 | Bedford Park-Fordham North | 54415 | 40.870100 | -73.885691 |
| 3 | Bronx | BX06 | Belmont | 27378 | 40.853451 | -73.889368 |
| 4 | Bronx | BX07 | Bronxdale | 35538 | 40.850656 | -73.866524 |

TABLE 2.7-POPULATION BREAKDOWN BY NEIGHBORHOOD FOR NEW YORK CITY

## 3. METHODOLOGY

As clearly stated in the introduction, our purpose is to use the data that have been collected so far to establish weak and strong points of the cities in the scope of this project as well as to compare these two cities to identify how similar they are. In order to do that, a well-established methodology must be set; the procedure to be followed during analysis consists of3 phases which are explained in the paragraphs below.

Firstly, comprehensive visualizations will be provided. This will be managed by generating choropleth maps which is useful to point out the population densities for each neighborhood and how each cultural facility scattered across the city.

Secondly, K-means clustering method will be called to group the neighborhoods to see what kind of venues are popular for each neighborhood. The neighborhoods will also be classified according to their population by K-means clustering. By performing this analysis, a picture will have been drawn showing what kind of cultural facilities are needed to enhance the cultural structure of each city and how homogenously the facilities are distributed across the city.

All the steps mentioned above will be followed separately for each city. After this point, as a final step, the findings will be compared to find out how similar Istanbul and New York City are and how differently they have grown culturally.

## 4. ANALYSIS

As dictated by the methodology, generation of choropleth maps is the first step of analysis followed by K-means clustering and comparison of findings.

### 4.1. Choropleth Maps

#### 4.1.1. Population

In this section, the aim is to create maps reflecting the population breakdown for both cities.

#### 4.1.1.1. Population Distribution in New York City

Choropleth map is a good visualization tool if the purpose is to reflect a distribution pattern across a place. By setting the borders of neighborhoods, the data acquired before are inserted into a map to generate the figure below.

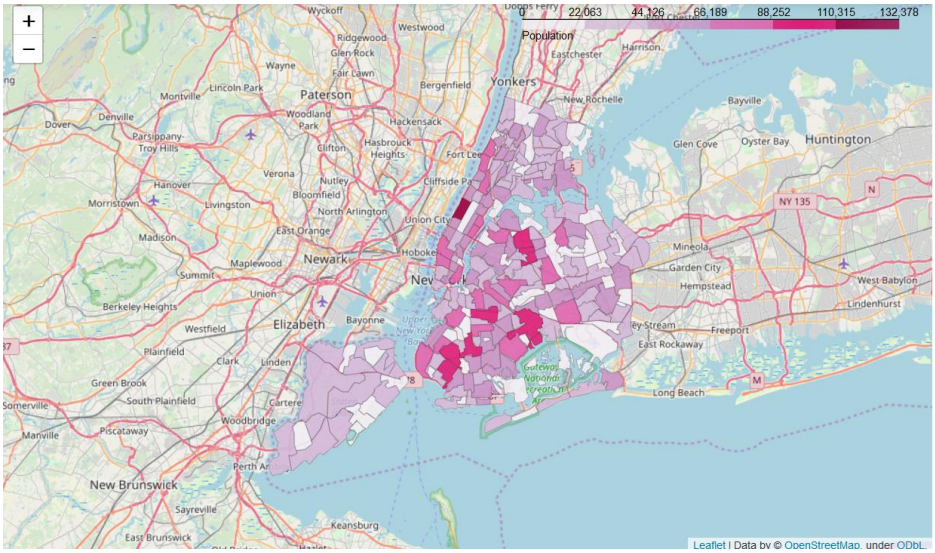



FIGURE 4.1-POPULATION DISTRIBUTION IN NEW YORK CITY

As clear in the figure, the areas with higher densities are highlighted with dark colors as the less populated areas are shown in lighter colors. 6 population zones are established and the least populated areas are white colored. Some zones are highly populated in the city. However, it is obvious that the population is not concentrated in just one area. Those high population zones are scattered across the city creating a homogenous pattern.

#### 4.1.1.2. Population Distribution in Istanbul

Following the same steps, the choropleth map has been produced as follows.

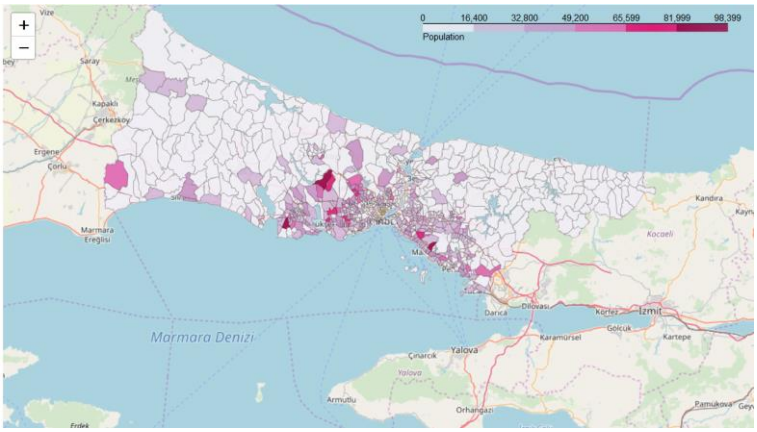



FIGURE 4.2-POPULATION DISTRIBUTION IN ISTANBUL

6 zones are also established for Istanbu. Unlike New York City, the population is not homogenously distributed across the city. The central zone seems to be highly populated compared to other areas.

### 4.1.2. Cultural Facilities

Choropleth maps will be generated for each cultural venue to provide a deeper insight of the distribution of each venue categories. The tables showing the number of each venues in each neighborhood will be utilized along with ones including geographic information created in data wrangling phase while creating maps.

| | id | category name | name | latitude | longitude | neighbourhood | borough | catnum |
|---|---|---|---|---|---|---|---|---|
| 0 | 4bf58dd8d48988d1e5931735 | Music Venue | The Upper Room | 40.892567 | -73.846406 | Wakefield | Bronx | 3 |
| 1 | 4bf58dd8d48988d1e5931735 | Music Venue | Par-City | 40.890211 | -73.847002 | Wakefield | Bronx | 3 |
| 2 | 4bf58dd8d48988d1e2931735 | Art Gallery | Art Gallery Illusion Reality | 40.894949 | -73.856470 | Wakefield | Bronx | 1 |
| 3 | 4bf58dd8d48988d1e5931735 | Music Venue | Matic Records | 40.899774 | -73.857141 | Wakefield | Bronx | 3 |
| 4 | 4bf58dd8d48988d1e5931735 | Music Venue | MY Studio | 40.901926 | -73.853504 | Wakefield | Bronx | 3 |

| | category_name | neighbourhood | id | name | latitude | longitude | borough | catnum |
|---|---|---|---|---|---|---|---|---|
| 0 | Art Gallery | Allerton | 4 | 4 | 4 | 4 | 4 | 4 |
| 1 | Art Gallery | Arrochar | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | Art Gallery | Arverne | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | Art Gallery | Astoria | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | Art Gallery | Astoria Heights | 4 | 4 | 4 | 4 | 4 | 4 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1231 | Public Art | Washington Heights | 1 | 1 | 1 | 1 | 1 | 1 |
| 1232 | Public Art | Weeksville | 1 | 1 | 1 | 1 | 1 | 1 |
| 1233 | Public Art | Williamsbridge | 1 | 1 | 1 | 1 | 1 | 1 |
| 1234 | Public Art | Windsor Terrace | 2 | 2 | 2 | 2 | 2 | 2 |
| 1235 | Public Art | Woodrow | 1 | 1 | 1 | 1 | 1 | 1 |

| | Borough | NTA Code | NTA Name | Population | latitude | longitude |
|---|---|---|---|---|---|---|
| 0 | Bronx | BX01 | Claremont-Bathgate | 31078 | 40.849893 | -73.895474 |
| 1 | Bronx | BX03 | Eastchester-Edenwald-Baychester | 34517 | 40.864322 | -73.843382 |
| 2 | Bronx | BX05 | Bedford Park-Fordham North | 54415 | 40.870100 | -73.885691 |
| 3 | Bronx | BX06 | Belmont | 27378 | 40.853451 | -73.889368 |
| 4 | Bronx | BX07 | Bronxdale | 35538 | 40.850656 | -73.866524 |
| ... | ... | ... | ... | ... | ... | ... |
| 190 | Staten Island | SI37 | Stapleton-Rosebank | 26453 | 40.628878 | -74.078479 |
| 191 | Staten Island | SI45 | New Dorp-Midland Beach | 21896 | 40.573994 | -74.115976 |
| 192 | Staten Island | SI48 | Arden Heights | 25238 | 40.556413 | -74.173504 |
| 193 | Staten Island | SI54 | Great Kills | 40720 | 40.554327 | -74.156292 |
| 194 | Staten Island | SI99 | park-cemetery-etc-Staten Island | 0 | 40.598989 | -74.167788 |

TABLE 4.1, 4.2, 4.3 -TABLES TO BE USED FOR NEW YORK CITY TO GENERATE CHOROPLETH MAPS

| | id | category name | name | latitude | longitude | neighbourhood | borough | catnum |
|---|---|---|---|---|---|---|---|---|
| 0 | 507c8c4091d498d9fc8c67a9 | Public Art | Kuaför Ali Ufuk Çimen | 40.880440 | 29.068968 | BURGAZADA MAH | ADALAR | 0 |
| 1 | 4bf58dd8d48988d1e5931735 | Music Venue | ASSK Disco | 40.879128 | 29.072280 | BURGAZADA MAH | ADALAR | 1 |
| 2 | 4bf58dd8d48988d1e2931735 | Art Gallery | İpek Burgazada | 40.880896 | 29.069002 | BURGAZADA MAH | ADALAR | 2 |
| 3 | 4deefb944765f83613cdba6e | Historic Site | Gönül Bağım | 40.880823 | 29.069742 | BURGAZADA MAH | ADALAR | 3 |
| 4 | 4bf58dd8d48988d1e5931735 | Music Venue | Büyükada Lunapark Restaurant | 40.857445 | 29.120468 | MADEN MAH | ADALAR | 1 |

| | category_name | borough | neighbourhood | id | name | latitude | longitude | catnum |
|---|---|---|---|---|---|---|---|---|
| 0 | Art Gallery | ADALAR | BURGAZADA | 1 | 1 | 1 | 1 | 1 |
| 1 | Art Gallery | ADALAR | KINALIADA | 1 | 1 | 1 | 1 | 1 |
| 2 | Art Gallery | ADALAR | NİZAM | 3 | 3 | 3 | 3 | 3 |
| 3 | Art Gallery | ARNAVUTKÖY | ANADOLU | 2 | 2 | 2 | 2 | 2 |
| 4 | Art Gallery | ARNAVUTKÖY | ARNAVUTKÖY MERKEZ | 2 | 2 | 2 | 2 | 2 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 4197 | Public Art | ŞİŞLİ | KUŞTEPE | 1 | 1 | 1 | 1 | 1 |
| 4198 | Public Art | ŞİŞLİ | MAHMUT ŞEVKET PAŞA | 1 | 1 | 1 | 1 | 1 |
| 4199 | Public Art | ŞİŞLİ | MERKEZ | 1 | 1 | 1 | 1 | 1 |
| 4200 | Public Art | ŞİŞLİ | MEŞRUTİYET | 1 | 1 | 1 | 1 | 1 |
| 4201 | Public Art | ŞİŞLİ | TEŞVİKİYE | 1 | 1 | 1 | 1 | 1 |

| | Borough | KIMLIKNO | AD | Population | public_art_number |
|---|---|---|---|---|---|
| 0 | ADALAR | 40141 | NİZAM | 3470 | 1 |
| 1 | ADALAR | 40143 | KINALIADA | 1758 | 0 |
| 2 | ADALAR | 40139 | BURGAZADA | 1427 | 1 |
| 3 | ADALAR | 40140 | MADEN | 13619 | 0 |
| 4 | ADALAR | 40142 | HEYBELİADA | 4253 | 0 |
| ... | ... | ... | ... | ... | ... |
| 970 | SULTANGAZİ | 40466 | YUNUS EMRE | 49821 | 3 |
| 971 | SULTANGAZİ | 40469 | GAZİ | 35205 | 2 |
| 972 | SULTANGAZİ | 40476 | MALKOÇOĞLU | 13409 | 2 |
| 973 | SULTANGAZİ | 40467 | 75. YIL | 32398 | 4 |
| 974 | SULTANGAZİ | 0 | ASKERİ BÖLGE | 0 | 0 |

TABLE 4.4, 4.5, 4.6 -TABLES TO BE USED FOR ISTANBUL TO GENERATE CHOROPLETH MAPS

### 4.1.2.1. Public Art Venue Distribution

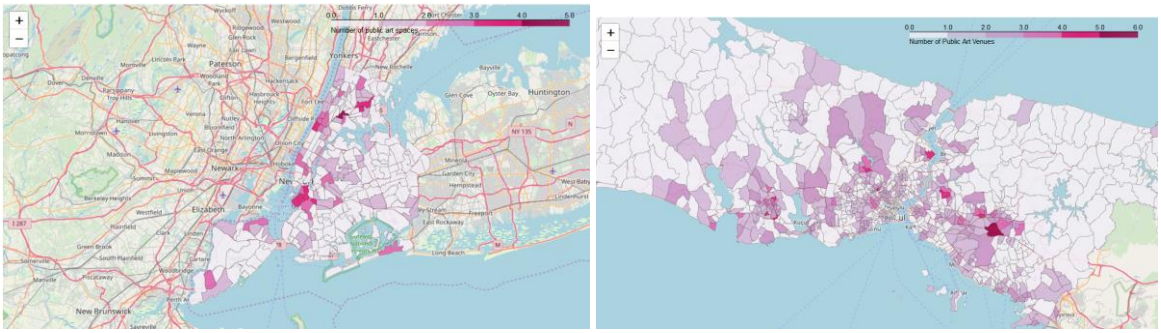



FIGURE 4.3-PUBLIC ART VENUE DISTRIBUTION

Analysis results reveal that 130 and 563 neighborhoods have no public art venues respectively in New York and İstanbul. Maps are in conformance with these numbers. Over half of both cities lacks public art venues. Therefore, it would be a good practice for the municipal authorities of both cities to open new public art centers and subsidize the efforts of people willing to provide funding for these places.

### 4.1.2.2. Art Gallery Distribution

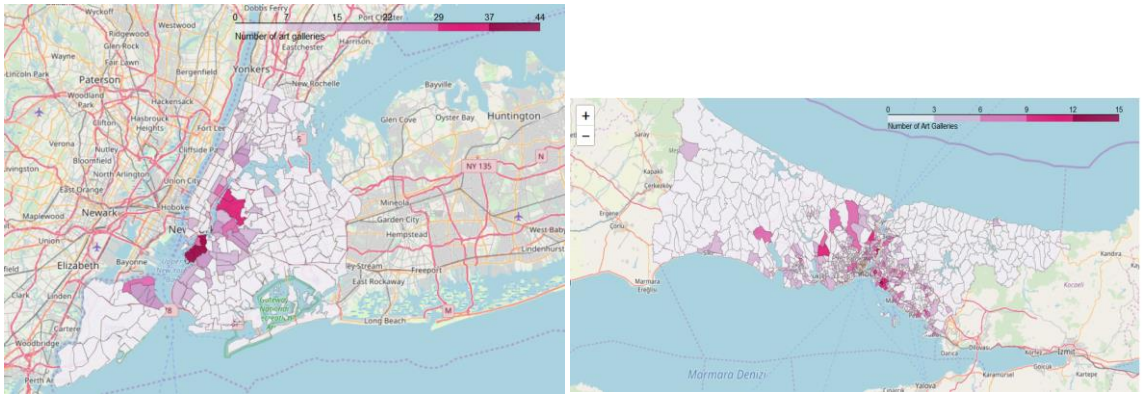



FIGURE 4.4-ART GALLERY DISTRIBUTION

The max number of art galleries in a neighborhood is much bigger in New York City than Istanbul. 37 areas have no art galleries in New York City while this number is 272 in Istanbul. It can be said that New York City is superior to Istanbul in terms of art gallery distribution across the city. Improvements can always be made in both cities but Istanbul needs more attention as to art galleries.

### 4.1.2.3. Historic Site Distribution

There are 77 areas with no historic site in New York city. Historic sites are not something to build as brand-new structures, so the areas with historic sites shall be paid attention. Improvements shall be made where necessary. In those areas where no historic sites are shown in the queries can be checked to identify whether any of the structures there can be considered as historic or not.

In Istanbul, 418 neighborhoods have no historic sites. It is not surprising that the historic sites are accumulated around Bosporus as the historic center of the city is located here.

Istanbul is an ancient city hosted many civilizations in the history. That is why the historic sites are more in Istanbul than New York City and those are concentrated in the historic center.

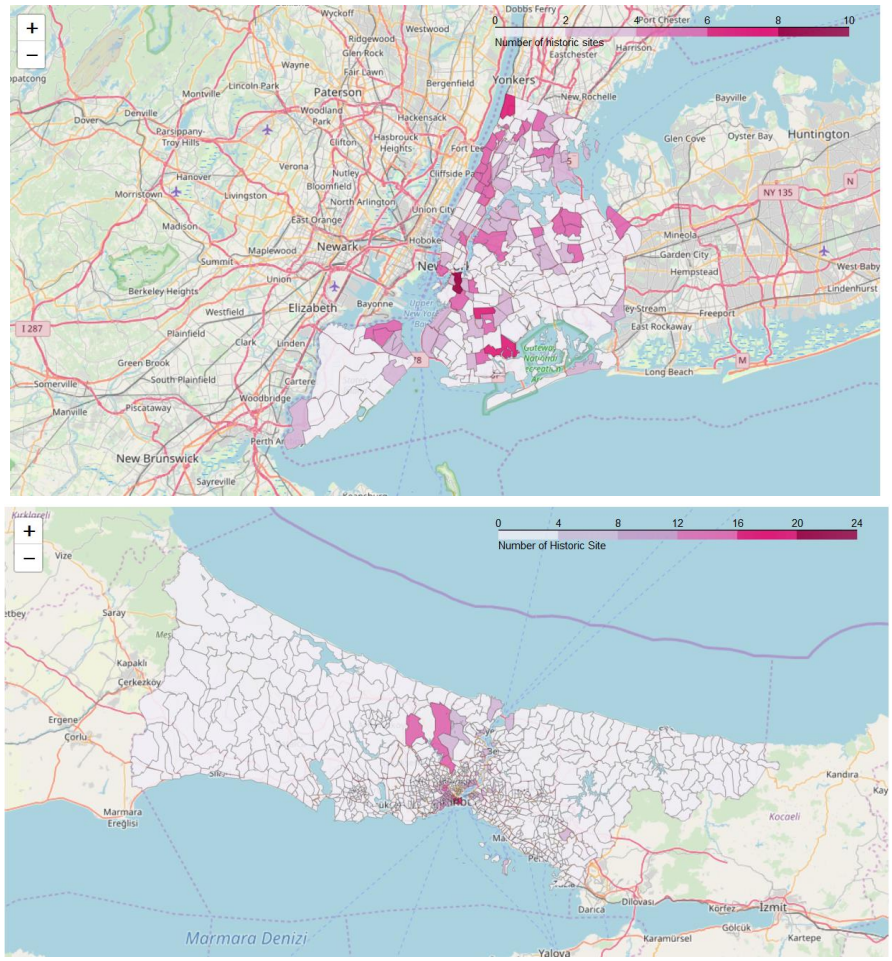



FIGURE 4.5-HISTORIC SITE DISTRIBUTION

### 4.1.2.4. Music Venue Distribution

In New York City, there are 37 areas with no music venues. Those neighborhoods may not be suitable for music venues, but some further research can be conducted to identify why there is none in those areas and if people require to have a music venue in their neighborhood, what kind of music they would prefer, if the residents request music venues in their neighborhoods.

263 neighborhoods in İstanbul don’t have any music venues. The residents of neighborhood with no music venues may be asked a questionnaire whether they would

prefer to have a music venue around or not, but it seems that the city has more than enough music venues.

Both New York City and Istanbul have the capability to meet the demand of residents.

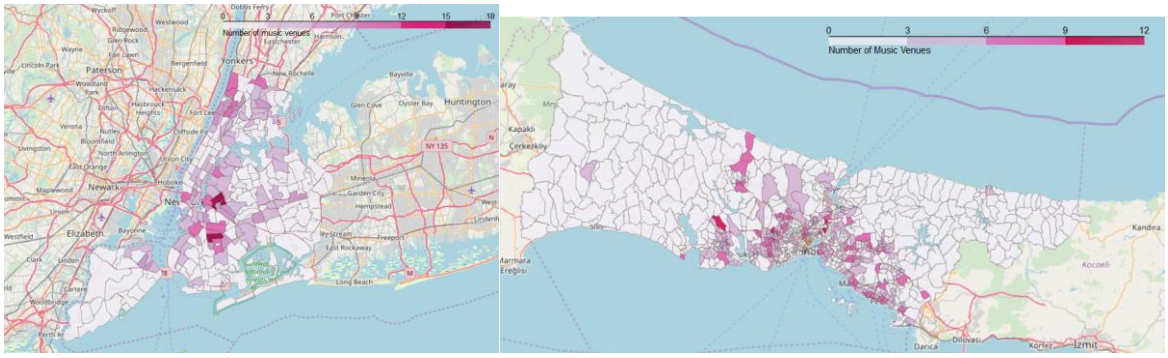



FIGURE 4.6-MUSIC VENUE DISTRIBUTION

### 4.1.2.5. Exhibition Areas Distribution

Not many exhibition areas available in New York City and these are concentrated just in a few areas. 161 neighborhoods have no exhibition areas.

In Istanbul, 816 neighborhoods have no exhibition areas similarly. However, those exhibition centers are dispersed not concentrated in just a few areas like New York City. The max. number that a neighborhood contains is 4 whereas these number is around 30 in New York City.

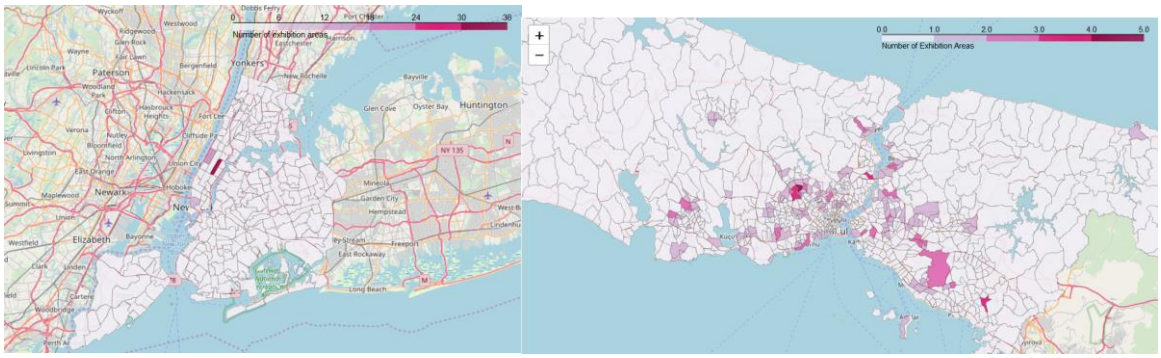



FIGURE 4.7-EXHIBITION AREAS DISTRIBUTION

### 4.1.2.6.Movie Theater Distribution

The maps below show the distribution of movie theaters across the city in New York City and Istanbul. 88 and 522 areas don't contain any movie theaters respectively in New York City and Istanbul. However, as various platforms are available to watch movies, it is highly likely that existing numbers of theaters meet the current demand.

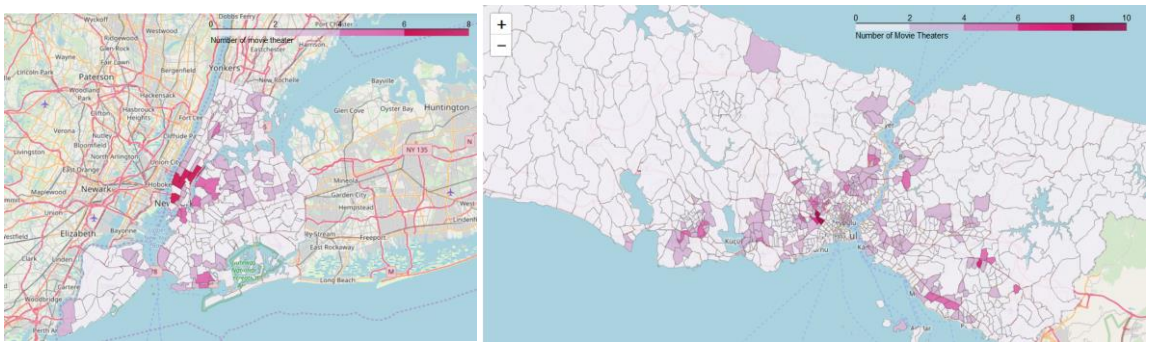



FIGURE 4.8-MOVIE THEATER DISTRIBUTION

### 4.1.2.7. Museum Distribution

140 and 780 neighborhoods in New York City and Istanbul respectively have no museum. Museums are not buildings that are built on demand, so this analysis do not address the question 'where to build a new museum of what type'. However, New York City seems to have more homogenous pattern compared to Istanbul.

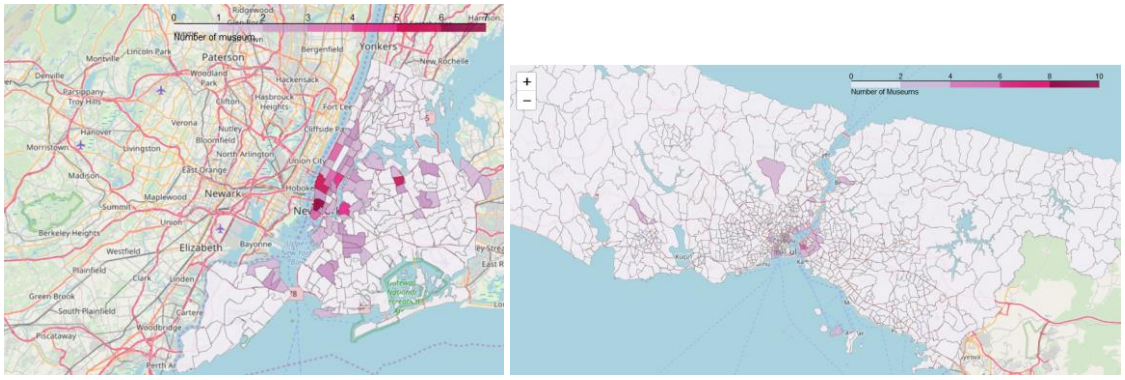



FIGURE 4.9-MUSEUM DISTRIBUTION

### 4.1.2.8. Concert Hall Distribution

113 and 492 neighborhoods in New York City and Istanbul respectively have no concert halls, but these are unique buildings and every neighborhood does not have to contain concert halls. If a new one is intended to be built, these maps can be a guide to determine the location of it.

The concert halls are dispersed in New York City compared to İstanbul where they are located in the center mostly.


FIGURE 4.10-CONCERT HALL DISTRIBUTION

### 4.1.2.9. Performing Art Venue Distribution

80 and 594 neighborhoods in New York City and Istanbul respectively have no performance art venues. New ones could be extended to other parts of the city.

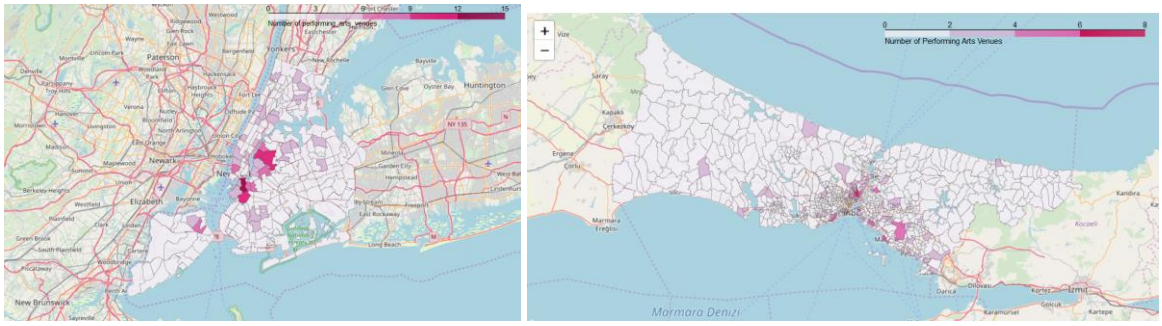



FIGURE 4.11-PERFORMING ART DISTRIBUTION

### 4.1.2.10. Memorial Site Distribution

Memorial sites are not something to build where there is none, so this analysis only shows where those are located.

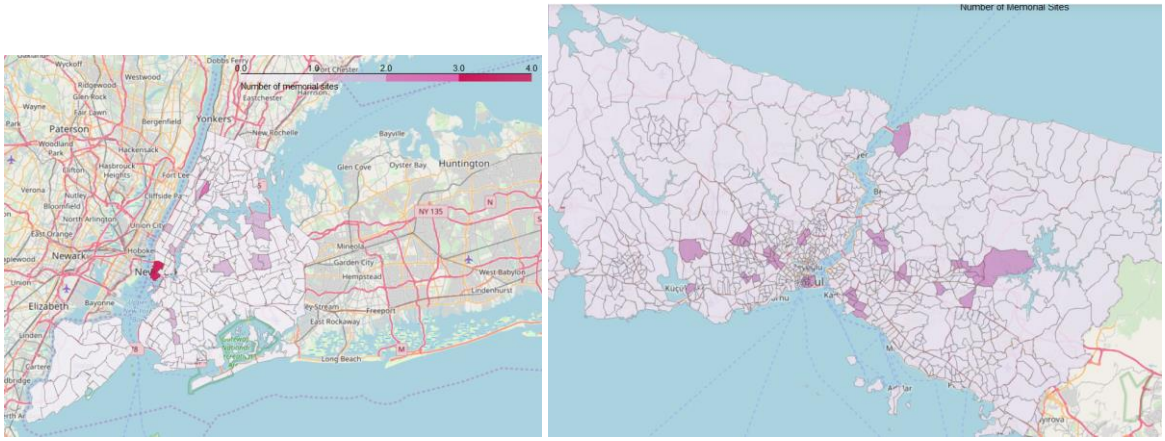



FIGURE 4.12-MEMORIAL SITE DISTRIBUTION

## 4.2. K-Means Clustering

In this phase of the analysis, K-means clustering method is invoked to work with unsupervised data sets. The aim is to find out how neighborhoods are grouped according to their population and cultural facility distribution.

### 4.2.1. Cultural Venue Clustering in Istanbul

Before K-Means clustering method is applied, the data needs to be prepared. First step is to group the cultural venues for each neighborhood to obtain the data frame below.

| | Neighborhood | Borough | KIMLIKNO | Public Art | Music Venue | Art Gallery | Historic Site | Exhibit | Movie Theater | Museum | Concert Hall | Performing Arts Venue | Memorial Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | NİZAM | ADALAR | 40141 | 1 | 2 | 3 | 5 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | KINALIADA | ADALAR | 40143 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | BURGAZADA | ADALAR | 40139 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | MADEN | ADALAR | 40140 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | HEYBELİADA | ADALAR | 40142 | 0 | 2 | 0 | 3 | 0 | 2 | 2 | 1 | 0 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 970 | YUNUS EMRE | SULTANGAZİ | 40466 | 3 | 8 | 2 | 2 | 0 | 0 | 0 | 3 | 0 | 0 |
| 971 | GAZİ | SULTANGAZİ | 40469 | 2 | 4 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 0 |
| 972 | MALKOÇOĞLU | SULTANGAZİ | 40476 | 2 | 0 | 2 | 3 | 0 | 1 | 0 | 1 | 1 | 0 |
| 973 | 75. YIL | SULTANGAZİ | 40467 | 4 | 6 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 0 |
| 974 | ASKERİ BÖLGE | SULTANGAZİ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 4.7 -NUMBER OF EACH VENUES GROUPED BY NEIGHBORHOOD(ISTANBUL)

In order to group the neighborhoods in a proper manner, number of clusters shall be determined. Elbow method is used to achieve that. A graph, distortion versus k number, is drawn in this method and number k is chosen where the drop in distortion values become insignificant.

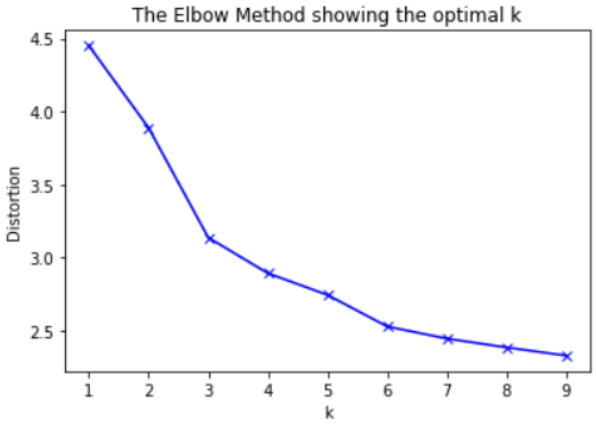



FIGURE 4.13-THE ELBOW METHOD(ISTANBUL)

As can be seen in the graph above, the slope of the line changes drastically where k is 6, meaning that increasing number of clusters doesn't provide a better modeling after this point. Therefore, k is chosen as 6.

The K-means method has been applied with k=6. Following data frame has been generated by adding the cluster column.

| | Neighborhood | Borough | KIMLIKNO | Public Art | Music Venue | Art Gallery | Historic Site | Exhibit | Movie Theater | Museum | Concert Hall | Performing Arts Venue | Memorial Site | Cluster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | NİZAM | ADALAR | 40141 | 1 | 2 | 3 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| 1 | KINALIADA | ADALAR | 40143 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 2 | BURGAZADA | ADALAR | 40139 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 3 | MADEN | ADALAR | 40140 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 4 | HEYBELİADA | ADALAR | 40142 | 0 | 2 | 0 | 3 | 0 | 2 | 2 | 1 | 0 | 0 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 970 | YUNUS EMRE | SULTANGAZİ | 40466 | 3 | 8 | 2 | 2 | 0 | 0 | 0 | 3 | 0 | 0 | 2 |
| 971 | GAZİ | SULTANGAZİ | 40469 | 2 | 4 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 |
| 972 | MALKOÇOĞLU | SULTANGAZİ | 40476 | 2 | 0 | 2 | 3 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 973 | 75. YIL | SULTANGAZİ | 40467 | 4 | 6 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 |
| 974 | ASKERİ BÖLGE | SULTANGAZİ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |

TABLE 4.8 -CLUSTERED NEIGHBORHOOD TABLE(ISTANBUL)

Another table has been created to see the type of most common venues in each neighborhood in descending order.

| | Borough | KIMLIKNO | Neighborhood | 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 | Cluster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | ADALAR | 40141 | NİZAM | Historic Site | Art Gallery | Music Venue | Exhibit | Public Art | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | 4 |
| 1 | ADALAR | 40143 | KINALIADA | Historic Site | Art Gallery | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | Exhibit | Music Venue | Public Art | 3 |
| 2 | ADALAR | 40139 | BURGAZADA | Historic Site | Art Gallery | Music Venue | Public Art | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | Exhibit | 3 |
| 3 | ADALAR | 40140 | MADEN | Historic Site | Music Venue | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | Exhibit | Art Gallery | Public Art | 3 |
| 4 | ADALAR | 40142 | HEYBELİADA | Historic Site | Museum | Movie Theater | Music Venue | Concert Hall | Memorial Site | Performing Arts Venue | Exhibit | Art Gallery | Public Art | 0 |

TABLE 4.9 -MOST COMMON VENUES IN DESCENDING ORDER(ISTANBUL)

In order to label the clusters properly, average number of each venues for each cluster has been calculated to generate the following table which is inserted into a histogram to provide a better visual.

| | Public Art | Music Venue | Art Gallery | Historic Site | Exhibit | Movie Theater | Museum | Concert Hall | Performing Arts Venue | Memorial Site |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.885496 | 1.870229 | 2.171756 | 1.198473 | 0.297710 | 1.358779 | 0.187023 | 1.244275 | 0.767176 | 0.080153 |
| 1 | 0.390244 | 1.439024 | 2.268293 | 14.951220 | 0.000000 | 0.658537 | 1.073171 | 0.439024 | 1.024390 | 0.365854 |
| 2 | 0.888350 | 5.480583 | 2.252427 | 1.053398 | 0.305825 | 0.990291 | 0.174757 | 1.116505 | 0.810680 | 0.087379 |
| 3 | 0.106464 | 0.220532 | 0.171103 | 0.171103 | 0.026616 | 0.060837 | 0.019011 | 0.129278 | 0.087452 | 0.003802 |
| 4 | 0.611940 | 1.910448 | 3.373134 | 6.776119 | 0.134328 | 0.388060 | 1.074627 | 0.716418 | 1.432836 | 0.000000 |
| 5 | 0.669118 | 2.852941 | 5.816176 | 1.617647 | 0.279412 | 1.404412 | 0.595588 | 1.330882 | 0.735294 | 0.036765 |

TABLE 4.10 -AVERAGE NUMBER OF EACH VENUES FOR EACH CLUSTER(ISTANBUL)

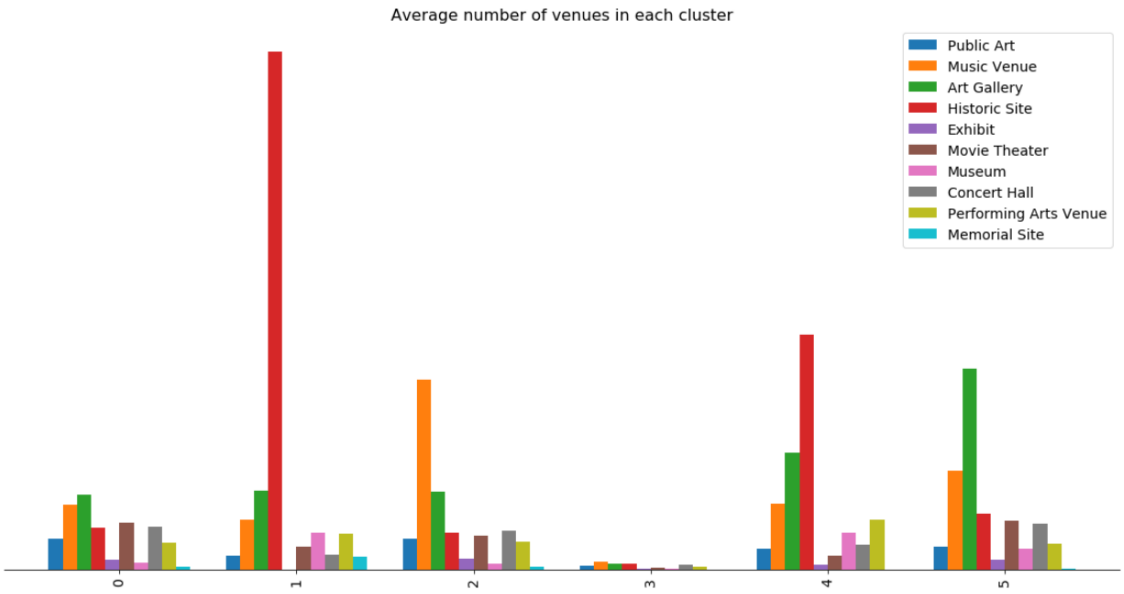



FIGURE 4.14-AVERAGE NUMBER OF VENUES(ISTANBUL)

In the light of the histogram shown above, clusters can be described as follows:

cluster 0: First clusters seems to involve all kind of venues but there is no distinguished one, so this cluster can be called as "Balanced number of cultural venues"

cluster 1: Historic venues by far distinguish themselves in this group, so the name "Historic venues" is given to this cluster.

cluster 2: Museums outnumbers other venues in this group so this group is called "Museum"

cluster 3: All 10 venues are small in number, so this group is called "Least number of cultural venues"

cluster 4: Historic sites and memorial sites are the top 2 cultural facilities in this group. The name "Historic and Memorial Sites" are given to this group.

cluster 5: Memorial sites and music venues are on the first and second rank respectively, so "Memorial and music venues" would be a good name to define this group.

Before creating a cluster map, population data will be inserted into the data frame which will be used to label neighborhoods in terms of their population level. The terminology used to define the population levels are as follows:

- VLP: Very low population <16400
- LP: Low Population <32800
- MLP: Very Low Population <49200
- MHP: Middle High Population<65599
- HP: High Population<81999
- VHP: Very High population<98399

Finally, a cluster map as shown below is generated.

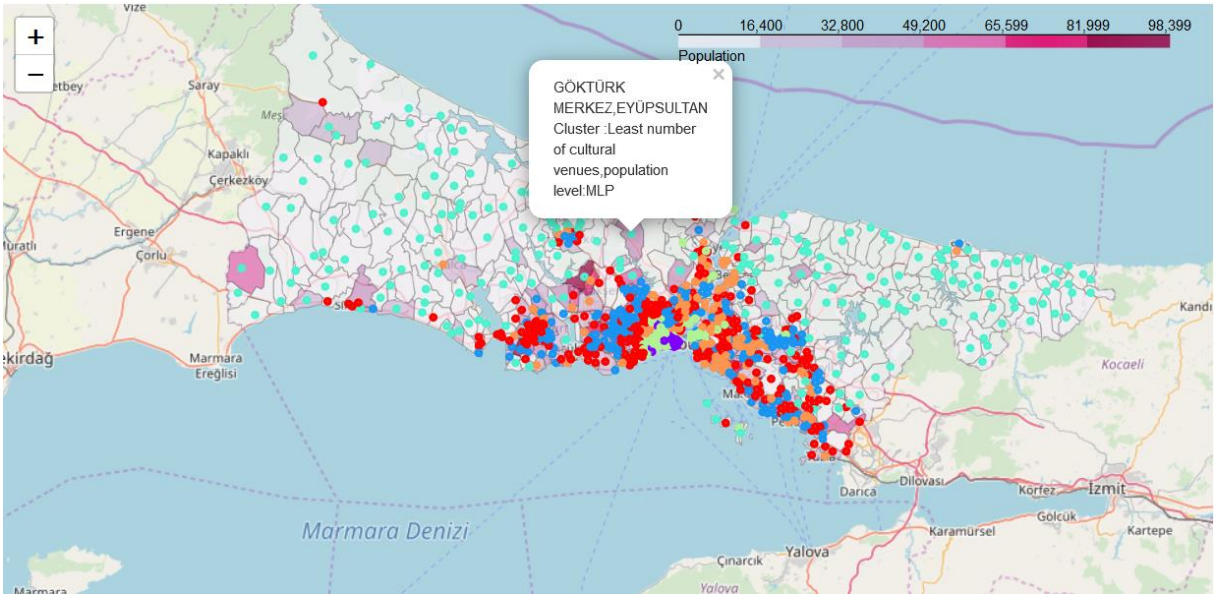



FIGURE 4.15-CLUSTER MAP(ISTANBUL)

When clicked on a marker, the cluster and population label are shown. It is clear that neighborhoods with low population density fall into “Least number of cultural venues” cluster and central zone is where the other groups are accumulated.

When clicked on a neighborhood located at the historic center of the city, the label of the cluster is returned unsurprisingly as “Historic venues” (please see the figure below).

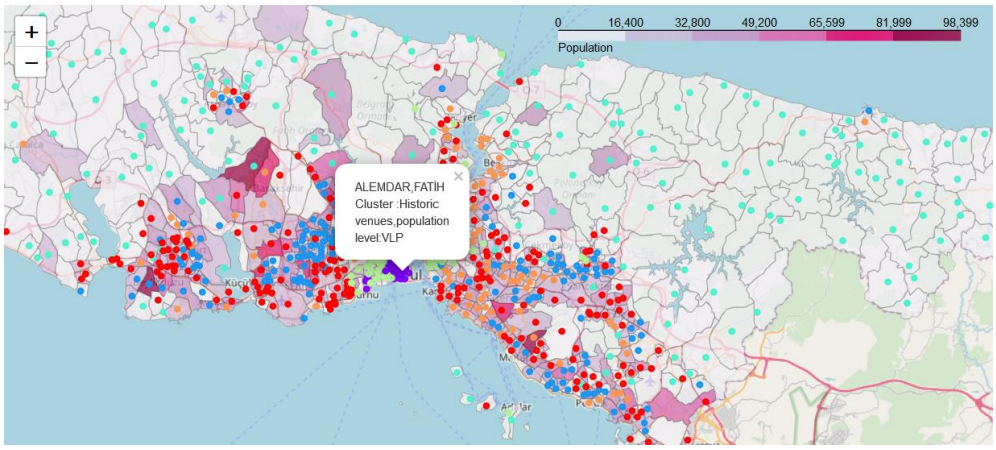



FIGURE 4.16-CLUSTER MAP SHOWING A NEIGHBORHOOD AT HISTORIC CENTER OF THE CITY(ISTANBUL)

### 4.2.2. Cultural Venue Clustering in New York City

Same procedure as in Istanbul's case is applied for New York City as well. Firstly, following data frame is generated.

| | NTA Code | Borough | NTA Name | Public Art | Music Venue | Art Gallery | Historic Site | Exhibit | Movie Theater | Museum | Concert Hall | Performing Arts Venue | Memorial Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | BX01 | Bronx | Claremont-Bathgate | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | BX03 | Bronx | Eastchester-Edenwald-Baychester | 0 | 3 | 2 | 1 | 0 | 2 | 0 | 1 | 0 | 0 |
| 2 | BX05 | Bronx | Bedford Park-Fordham North | 1 | 6 | 3 | 2 | 1 | 1 | 1 | 3 | 1 | 0 |
| 3 | BX06 | Bronx | Belmont | 0 | 4 | 2 | 2 | 5 | 0 | 0 | 3 | 0 | 0 |
| 4 | BX07 | Bronx | Bronxdale | 1 | 4 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 0 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 190 | SI37 | Staten Island | Stapleton-Rosebank | 1 | 2 | 14 | 2 | 0 | 0 | 1 | 3 | 2 | 0 |
| 191 | SI45 | Staten Island | New Dorp-Midland Beach | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 192 | SI48 | Staten Island | Arden Heights | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 193 | SI54 | Staten Island | Great Kills | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 194 | SI99 | Staten Island | park-cemetery-etc-Staten Island | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 4.11 -NUMBER OF EACH VENUES GROUPED BY NEIGHBORHOOD(NY CITY)

K value determination using the elbow method is the next step. The graph below dictates what k number is taken for the K-means cluster method.

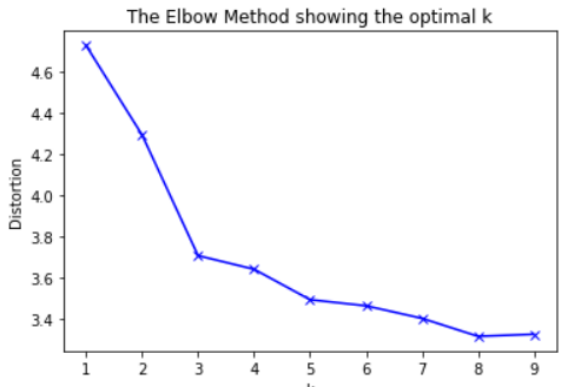



FIGURE 4.17-THE ELBOW METHOD(NY CITY)

k is determined as 8 per the elbow method. The analysis is performed with k=8. The output is the following data frame.

| | NTA Code | Borough | NTA Name | Public Art | Music Venue | Art Gallery | Historic Site | Exhibit | Movie Theater | Museum | Concert Hall | Performing Arts Venue | Memorial Site | Cluster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | BX01 | Bronx | Claremont-Bathgate | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | BX03 | Bronx | Eastchester-Edenwald-Baychester | 0 | 3 | 2 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 5 |
| 2 | BX05 | Bronx | Bedford Park-Fordham North | 1 | 6 | 3 | 2 | 1 | 1 | 1 | 3 | 1 | 0 | 2 |
| 3 | BX06 | Bronx | Belmont | 0 | 4 | 2 | 2 | 5 | 0 | 0 | 3 | 0 | 0 | 5 |
| 4 | BX07 | Bronx | Bronxdale | 1 | 4 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 0 | 2 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 190 | SI37 | Staten Island | Stapleton-Rosebank | 1 | 2 | 14 | 2 | 0 | 0 | 1 | 3 | 2 | 0 | 7 |
| 191 | SI45 | Staten Island | New Dorp-Midland Beach | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 192 | SI48 | Staten Island | Arden Heights | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 193 | SI54 | Staten Island | Great Kills | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 194 | SI99 | Staten Island | park-cemetery-etc-Staten Island | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**TABLE 4.12 -CLUSTERED NEIGHBORHOOD TABLE(NY CITY)**

The data frame showing most common venues in descending order has been created as follows.

| | Borough | NTA Name | 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 | Cluster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Bronx | Claremont-Bathgate | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | Exhibit | Historic Site | Art Gallery | Music Venue | Public Art | 0 |
| 1 | Bronx | Eastchester-Edenwald-Baychester | Music Venue | Movie Theater | Art Gallery | Concert Hall | Historic Site | Memorial Site | Performing Arts Venue | Museum | Exhibit | Public Art | 5 |
| 2 | Bronx | Bedford Park-Fordham North | Music Venue | Concert Hall | Art Gallery | Historic Site | Performing Arts Venue | Museum | Movie Theater | Exhibit | Public Art | Memorial Site | 2 |
| 3 | Bronx | Belmont | Exhibit | Music Venue | Concert Hall | Historic Site | Art Gallery | Memorial Site | Performing Arts Venue | Museum | Movie Theater | Public Art | 5 |
| 4 | Bronx | Bronxdale | Music Venue | Performing Arts Venue | Movie Theater | Exhibit | Historic Site | Art Gallery | Public Art | Memorial Site | Concert Hall | Museum | 2 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 190 | Staten Island | Stapleton-Rosebank | Art Gallery | Concert Hall | Performing Arts Venue | Historic Site | Music Venue | Museum | Public Art | Memorial Site | Movie Theater | Exhibit | 7 |
| 191 | Staten Island | New Dorp-Midland Beach | Art Gallery | Historic Site | Music Venue | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | Exhibit | Public Art | 0 |
| 192 | Staten Island | Arden Heights | Concert Hall | Memorial Site | Performing Arts Venue | Museum | Movie Theater | Exhibit | Historic Site | Art Gallery | Music Venue | Public Art | 0 |
| 193 | Staten Island | Great Kills | Music Venue | Art Gallery | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | Exhibit | Historic Site | Public Art | 0 |
| 194 | Staten Island | park-cemetery-etc-Staten Island | Memorial Site | Performing Arts Venue | Concert Hall | Museum | Movie Theater | Exhibit | Historic Site | Art Gallery | Music Venue | Public Art | 0 |

**TABLE 4.13 -MOST COMMON VENUES IN DESCENDING ORDER(NY CITY)**

Average number of each venues for each cluster is used to build a histogram to identify the patter of clusters and then clusters are labeled accordingly.

| | Public Art | Music Venue | Art Gallery | Historic Site | Exhibit | Movie Theater | Museum | Concert Hall | Performing Arts Venue | Memorial Site |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.230769 | 0.794872 | 0.935897 | 0.358974 | 0.076923 | 0.512821 | 0.038462 | 0.256410 | 0.269231 | 0.025641 |
| 1 | 0.875000 | 5.437500 | 8.687500 | 1.625000 | 0.312500 | 1.062500 | 0.750000 | 1.250000 | 3.062500 | 0.062500 |
| 2 | 0.333333 | 5.233333 | 3.033333 | 1.333333 | 0.200000 | 0.800000 | 0.300000 | 0.666667 | 1.133333 | 0.033333 |
| 3 | 1.000000 | 1.000000 | 28.000000 | 1.000000 | 0.000000 | 0.000000 | 1.000000 | 2.000000 | 2.000000 | 0.000000 |
| 4 | 0.714286 | 1.285714 | 6.333333 | 1.523810 | 0.238095 | 1.666667 | 0.857143 | 1.000000 | 1.380952 | 0.047619 |
| 5 | 0.388889 | 2.111111 | 2.500000 | 2.388889 | 0.722222 | 1.222222 | 0.833333 | 1.027778 | 1.722222 | 0.361111 |
| 6 | 0.000000 | 1.500000 | 3.500000 | 1.000000 | 13.000000 | 1.500000 | 2.000000 | 1.500000 | 0.500000 | 0.000000 |
| 7 | 1.090909 | 2.818182 | 13.272727 | 1.363636 | 0.636364 | 1.000000 | 0.363636 | 1.090909 | 1.727273 | 0.000000 |

**TABLE 4.14 -AVERAGE NUMBER OF EACH VENUES FOR EACH CLUSTER(NY CITY)**

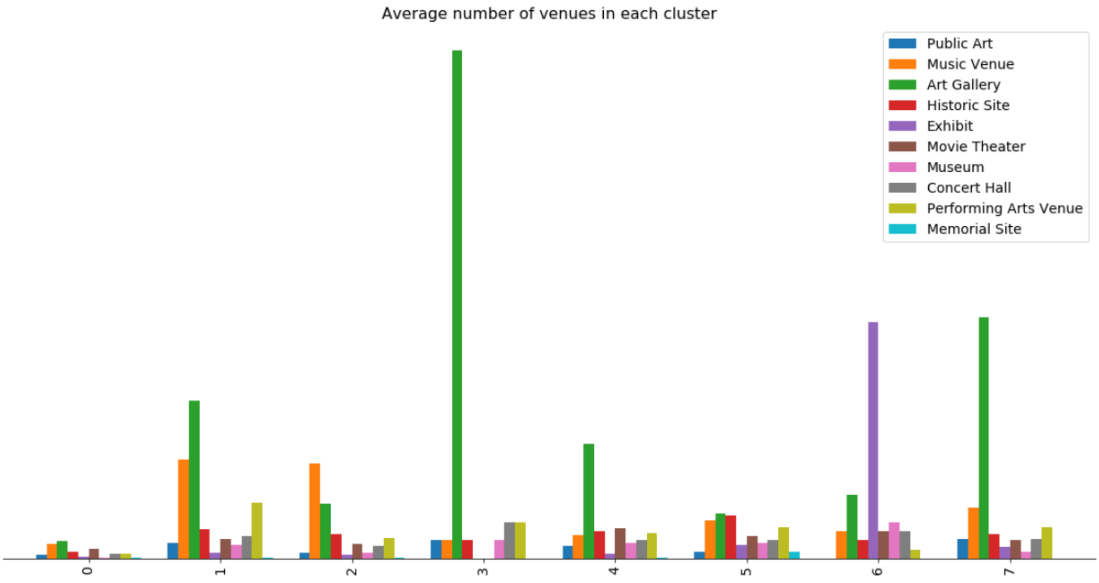



FIGURE 4.18-AVERAGE NUMBER OF VENUES(NY CITY)

Clusters are labeled as follows according to histogram above:

Cluster 0: “Least number of venues”

Cluster 1: “Moderate number of Art Galleries, Music Venues and Performing Art Venues”

Cluster 2: ”Moderate number of Music Venues and Art galleries ”

Cluster 3: “Largest number of Art Galleries”

Cluster 4: “Several Cultural Venues with relatively large number of venues”

Cluster 5: “Balanced number of venues”

Cluster 6: ”Largest number of Exhibition areas”

Cluster 7:”Second largest amount of art galleries”

The populations classes are defined as follows:

- VLP: Very low population <22063
- LP: Low Population <44126
- MLP: Very Low Population <66189
- MHP: Middle High Population<88252
- HP: High Population<110315
- VHP: Very High population<132378

The following map is the reward of all the effort that has been put so far.

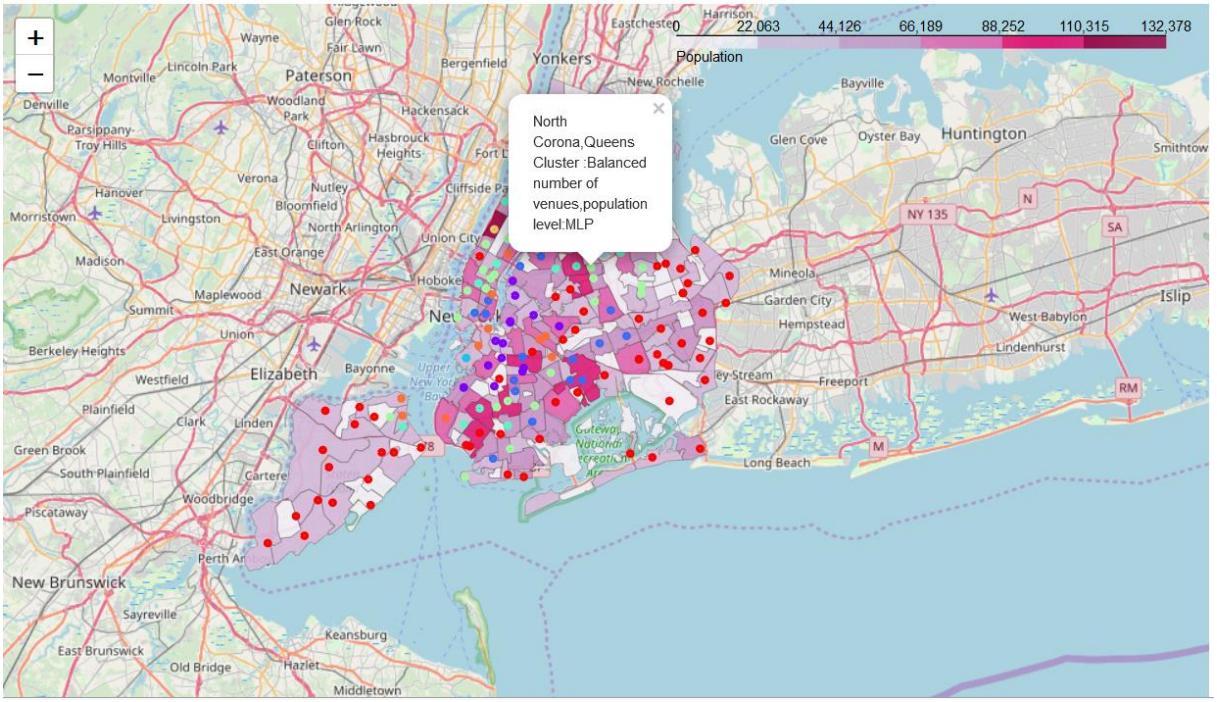



FIGURE 4.19-CLUSTER MAP SHOWING A NEIGHBORHOOD AT HISTORIC CENTER OF THE CITY(NY CITY)

The red markers indicate neighborhoods with least amount of venues. Significant number of neighborhoods fall in this group. Second group is blue one representing moderate number of music venues and art galleries.

To sum up, large amount of cultural venues is accumulated in the central zone and outward zones contain least number of cultural venues.

### 4.3. Comparison between New York City and Istanbul

Each City has been analyzed separately in terms of demographics and cultural facility distribution. In this section, it is intended to compare New York City and Istanbul to figure out out to what degree they differ from each other. Population Data and cultural venue distribution will be at the center of the comparison.

#### 4.3.1. Comparison of Population data

To begin with, the total population will be compared. In terms of total population, Istanbul almost doubles New York City.

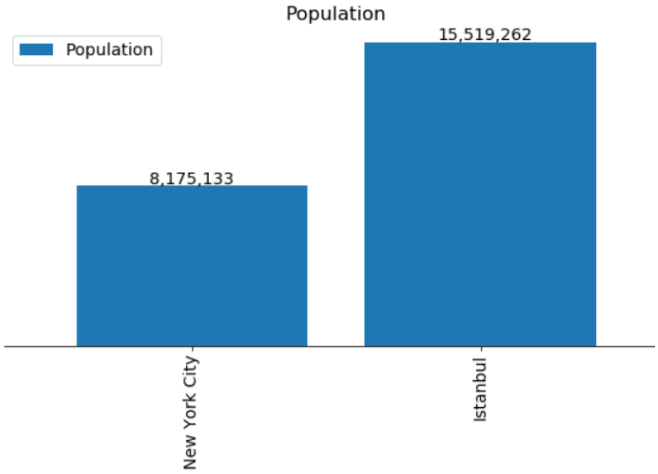



FIGURE 4.19-COMPARISON OF TOTAL POPULATION

In order to compare the homogeneity of population, the percentage of each population level will be analyzed and a histogram will be generated.

| | VLP | LP | MLP | MHP | HP | VHP |
|---|---|---|---|---|---|---|
| New York City | 14.87% | 46.67% | 24.10% | 10.26% | 3.59% | 0.51% |
| Istanbul | 61.64% | 25.54% | 9.23% | 2.46% | 0.82% | 0.31% |

TABLE 4.15 -PERCENTAGE SHARE OF NEIGHBORHOODS FOR EACH POPULATION CLASS

The table above shows totally different population distribution; 61.64% of neighborhoods in Istanbul falls within VLP (Very low Population) Zone, whereas this percentage is 14.87% in New York City.

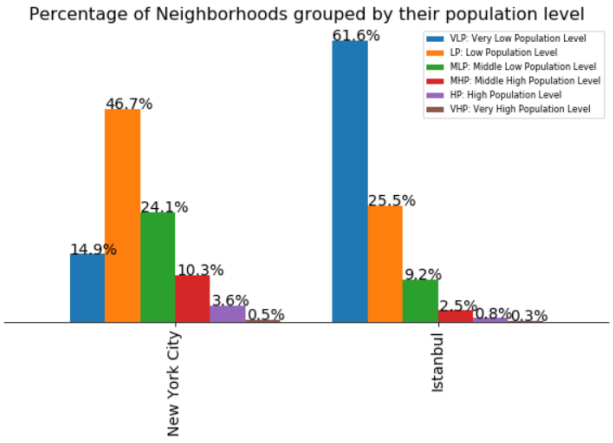



FIGURE 4.19- HISTOGRAM-PERCENTAGE OF NEIGHBORHOODS GROUPED BY THEIR POPULATION LEVEL

Another data frame and histogram need to be created to find out what the percentage share of each population class is.

| | VLP | LP | MLP | MHP | HP | VHP |
|---|---|---|---|---|---|---|
| New York City | 5.49% | 35.34% | 30.88% | 18.21% | 8.47% | 1.62% |
| Istanbul | 22.52% | 38.79% | 23.58% | 9.25% | 3.95% | 1.91% |

TABLE 4.15 -PERCENTAGE SHARE OF EACH POPULATION CLASS

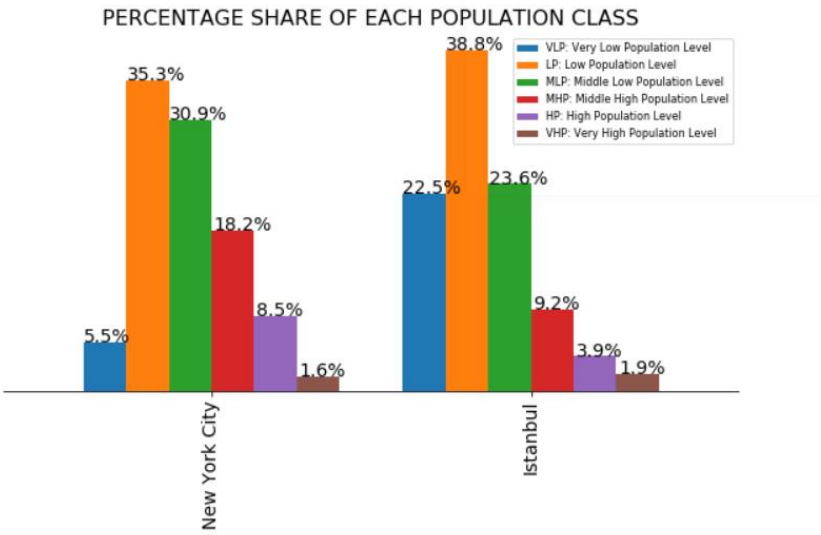



FIGURE 4.20- HISTOGRAM- PERCENTAGE SHARE OF EACH POPULATION CLASS

The outcome of the analysis indicates that the population in New York city is more homogenously distributed than Istanbul. In Istanbul, even though 61.64% of neighborhoods are in very low population zone, this translates only into 22.5% of the total population. On the other hand, 14.9% of neighborhoods with low population level covers only 5.5% of the population in New York City. Neighborhoods with the label "LP","VLP" and "MLP" , which constitutes 85.7% of total neighborhoods in New York city, have 71.7% of total population whereas 96.3% of total neigborhoods in Istanbul, which are labelled as"LP","VLP" and "MLP", contain 84.9% of total population.

### 4.3.1. Comparison of Cultural Facilities

Cluster maps have been generated for both cities. In this section, the type of clusters and the distribution of these clusters will be compared.

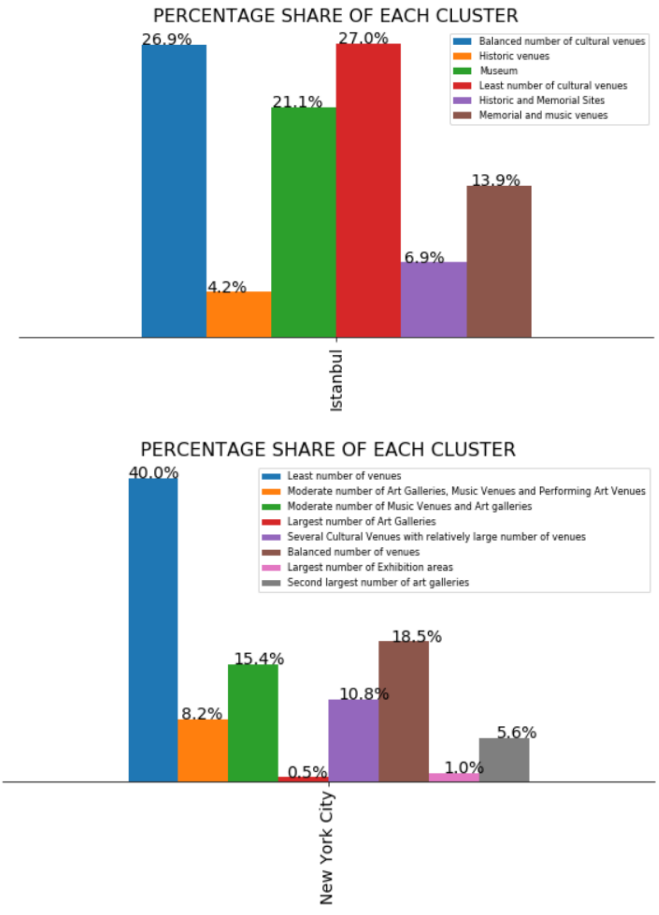
By means of elbow method, different cluster numbers have been chosen for each city. This means that neighborhoods are grouped in different manners. If the maps are examined carefully, different clustering patterns are easily spotted.

First of all, a data frame and a histogram will be created to ascertain the clustering patterns of each city. The table and the histogram will reflect the percentage share of each clusters.

| | Balanced number of cultural venues | Historic venues | Museum | Least number of cultural venues | Historic and Memorial Sites | Memorial and music venues |
|---|---|---|---|---|---|---|
| Istanbul | 26.87% | 4.21% | 21.13% | 26.97% | 6.87% | 13.95% |

| | Least number of venues | Moderate number of Art Galleries, Music Venues and Performing Art Venues | Moderate number of Music Venues and Art galleries | Largest number of Art Galleries | Several Cultural Venues with relatively large number of venues | Balanced number of venues | Largest number of Exhibition areas | Second largest number of art galleries |
|---|---|---|---|---|---|---|---|---|
| New York City | 40.00% | 8.21% | 15.38% | 0.51% | 10.77% | 18.46% | 1.03% | 5.64% |

TABLE 4.16 -PERCENTAGE SHARE OF EACH POPULATION CLASS




The group names and the cluster pattern are different. 40% of neighborhoods in New York city are classified as “Least number of venues” whereas 27% of neighborhoods in Istanbul are considered as “Least number of venues”.

As can be interpreted from the figure above, Historic venues, museums and memorial sites are distinguished venues in Istanbul whereas Exhibition areas,  Art Galleries, Music Venues and Performing art Venues take the center stage.

## 5. RESULTS AND DISCUSSION

The analysis consists of three sections. In the first section, choropleth maps have been generated for each venue. This provides a deeper insight into the distribution each category of cultural venues. In Istanbul, low population zones lack cultural venues whereas In New York City, the distribution is more homogenous.

In the second part of Analysis, K-means clustering method have been applied to both cities. As a result, different clustering patterns have been observed. As Istanbul is historically significant city, it is not surprising that the number of historic sites, museums and memorial sites are in the forefront per the analysis outcome. On the other hand, Exhibition areas, Art Galleries, Music Venues and Performing art Venues determine the clustering pattern.

In the final phase of analysis, these two metropolitan cities have been compared in terms of population distribution and clustering pattern. Neighborhoods with very low population outnumbers other neighborhoods with different level of population in Istanbul. However, Population in these neighborhoods are significantly smaller. In New York City, the population is distributed homogenously. As to cultural facilities, number of clusters and determining factors are different for each city. It can be concluded that cultural venues are scattered more evenly in New York City than in Istanbul.

The analysis depends on the data obtained from web sources. Some venues may have been miscategorized affecting the outcome of the analysis. However, it is our belief that the effect of mis-categorization is not significant.

This study can be extended further to spot the weak and strong points of these cities. Distribution of Sport venues, Education facilities, health services, etc. are the possible subjects for the further analysis.

## 6. CONCLUSION

The starting point of this study was to develop a better insight into population patterns and cultural formation of the two metropolitan cities, Istanbul and New York city. In addition to that, it was intended to address the problems with cultural facilities as to their distribution across the city. A methodology has been set to achieve our goal. Analysis has been divided into three parts, which are Choropleth maps generation, K-means clustering and comparison between these two cities, to serve the purpose. In the Results and Discussion section, all the findings have been compiled to draw a comprehensive picture.