



# APPLIED DATA SCIENCE CAPSTONE PROJECT

## The Battle of Neighborhoods

### Final Report

This is the final report of the IBM Coursera applied data science capstone project. The report compares Manhattan, NYC to Barcelona, Spain and recommends best locations for coffee shops in Barcelona based on performance data from NYC.

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## Introduction / Business Problem

“Metropolitan Café”, an US-based coffee shop franchise company wants to enter European market. They chose Barcelona, Spain as the first city where they want to try their concept in the EU and open two coffee shops. Barcelona is a vibrant Mediterranean city in the north-east of Spain. It is the capital and largest city of Catalonia, as well as the second most populous municipality of Spain with a population of 1.6 million within city limits. The city spreads on 101.4 km<sup>2</sup> (39.2 sq mi) area.

“Metropolitan Café” offers two coffee shop concepts:

- “Hip Café” is their premium offering for mid- to high-end of the market; these coffee shops are usually placed in the best locations in the city;
- “Budget Café” is their low-cost offering, targeting price-conscious customers; these coffee shops are usually placed in cheaper locations; however, these locations must share certain characteristics with locations of their premium offering.

“Metropolitan Café” bases all their business decisions on data. In the past years, they have collected large data sets from their US coffee shops. Data shows that their best coffee shops (in terms of revenues, profits, and customer satisfaction) are located in:

- Gramercy, Manhattan, New York
- Turtle Bay, Manhattan, New York
- Little Italy, Manhattan, New York
- West Village, Manhattan, New York
- Manhattanville, Manhattan, New York

The purpose of the project is to answer the following question: **what are the best locations to open “Hip Café” and “Budget Café” in Barcelona, Spain?**

As Metropolitan Café has no data on Barcelona or Spain in general, we have to answer that question by trying to find locations in Barcelona with similar characteristics to their best performing locations in New York City.

# Data

## Districts and Neighborhoods

As we aim to compare Manhattan, New York City with Barcelona, Spain, first we have to collect data of districts and neighborhoods of the two cities.

For the city of New York, we shall use the data provided by the Applied data science course “newyork\_data.json” which can be obtained from [https://cocl.us/new\\_york\\_dataset](https://cocl.us/new_york_dataset). An example of a record in the dataset is:

```
{'type': 'Feature',
  'id': 'nyu_2451_34572.105',
  'geometry': {'type': 'Point',
    'coordinates': [-73.9573853935188, 40.8169344294978]}},
  'geometry_name': 'geom',
  'properties': {'name': 'Manhattanville',
    'stacked': 2,
    'annoline1': 'Manhattanville',
    'annoline2': None,
    'annoline3': None,
    'annoangle': 0.0,
    'borough': 'Manhattan',
    'bbox': [-73.9573853935188,
      40.8169344294978,
      -73.9573853935188,
      40.8169344294978]}}
```

The dataset provides boroughs, neighborhoods, and their coordinates. We are only interested in the borough of Manhattan. We shall rename the borough column to “District” and add a column “District\_ID” to the dataset. As there is only one Borough/District (Manhattan), all rows get District\_Id = 0. In Barcelona, however, there will be several districts, each district will get its unique ID.

	District_ID	District	Neighborhood	Latitude	Longitude
0	0	Manhattan	Marble Hill	40.876551	-73.910660
1	0	Manhattan	Chinatown	40.715618	-73.994279
2	0	Manhattan	Washington Heights	40.851903	-73.936900
3	0	Manhattan	Inwood	40.867684	-73.921210
4	0	Manhattan	Hamilton Heights	40.823604	-73.949688
5	0	Manhattan	Manhattanville	40.816934	-73.957385

**FIGURE 1: MANHATTAN, NYC DISTRICTS (BOROUGH) AND NEIGHBORHOODS**

The source for Barcelona districts and neighborhoods will be Wikipedia [1]. Barcelona has 10 districts and each district has several neighborhoods. By scrapping the Wikipedia page we will get the data in the format suitable for data analysis.

Number	District	Size km²	Population	Density hab/km	Neighbourhoods	Councilman	Party
1	Ciutat Vella	4.49	111,290	24,786	La Barceloneta, El Gòtic, El Raval, Sant Pere, Santa Caterina i la Ribera	Gala Pin Ferrando	Barcelona en Comú
2	Eixample	7.46	262,485	35,586	L'Antiga Esquerra de l'Eixample, La Nova Esquerra de l'Eixample, Dreta de l'Eixample, Fort Plenc, Sagrada Família, Sant Antoni	Gerardo Pisarello Prados	Barcelona en Comú
3	Sants-Montjuïc	21.35	177,636	8,321	La Bordeta, la Font de la Guatlla, Hostafrancs, la Marina de Port, la Marina del Prat Vermell, El Poble-sec, Sants, Sants-Badal, Montjuïc*, Zona Franca - Port*	Laura Pérez Castaño	Barcelona en Comú
4	Les Corts	6.08	82,588	13,584	les Corts, la Maternitat i Sant Ramon, Pedralbes	Agustí Colom Cabau	Barcelona en Comú
5	Sarrià-Sant Gervasi	20.09	140,461	6,992	El Putget i Farrò, Sarrià, Sant Gervasi - la Bonanova, Sant Gervasi - Galvany, les Tres Torres, Valldorera, Tibidabo i les Planes	Jaume Asens Llodrà	Barcelona en Comú
6	Gràcia	4.19	120,087	28,660	Vila de Gràcia, el Camp d'en Grassot i Gràcia Nova, la Salut, el Coll, Valcarlos i els Penitents.	Eloi Badia Casas	Barcelona en Comú
7	Horta-Guinardó	11.96	169,920	14,217	El Baix Guinardó, El Guinardó, Can Baró, El Carmel, la Font d'en Fargues, Horta, la Clota, Montbau, Sant Genís dels Agudells, la Teixonera, La Vall d'Hebron.	Mercedes Vidal Lago	Barcelona en Comú
8	Nou Barris	8.04	164,981	20,520	Can Peguera, Canyelles, Ciutat Meridiana, La Guineueta, Porta, La Prosperitat, les Roquetes, Torre Baró, la Trinitat Nova, El Turó de la Peira, Vallbona, Verdum, Vilapicina i la Torre Llobeta	Janet Sanz Cid	Barcelona en Comú
9	Sant Andreu	6.56	142,598	21,737	Baró de Viver, Bon Pastor, El Congrés i els Indians, Navas, Sant Andreu de Palomar, La Sagrera i Trinitat Vella	Laia Ortiz Castelví	Barcelona en Comú
10	Sant Martí	10.80	221,029	20,466	El Besòs i el Maresme, el Clot, El Camp de l'Arpa del Clot, Diagonal Mar i el Front Marítim del Poblenou, el Parc i la Llacuna del Poblenou, Poblenou, Provençals del Poblenou, Sant Martí de Provençals, La Verneda i la Pau, la Vila Olímpica del Poblenou	Josep Maria Montaner Martorell	Barcelona en Comú

FIGURE 2: WIKI PAGE WITH BARCELONA DISTRICTS

Wiki does not provide location data (coordinates) for Barcelona neighborhoods. We have to obtain that data using GeoPy geocoder.

Finally, Barcelona scrapped and location enriched data has to be merged with the NYC data. For easier manipulation we shall persist the result of processing into a .csv file (bcn\_nyc.csv).

District_ID	District	Neighborhood	Latitude	Longitude
...	...	...	...	...
26	0 Manhattan	Morningside Heights	40.808000	-73.963896
27	0 Manhattan	Gramercy	40.737210	-73.981376
28	0 Manhattan	Battery Park City	40.711932	-74.016869
29	0 Manhattan	Financial District	40.707107	-74.010665
...	...	...	...	...
80	7 Horta-Guinardó	la Font d'en Fargues	41.425480	2.166410
81	7 Horta-Guinardó	Horta	41.438200	2.157950
82	7 Horta-Guinardó	la Clota	41.429120	2.152680
83	7 Horta-Guinardó	Montbau	41.432510	2.142300
84	7 Horta-Guinardó	Sant Genís dels Agudells	41.428020	2.133480
85	7 Horta-Guinardó	la Teixonera	41.423070	2.144820

FIGURE 3: MERGED NYC AND BARCELONA DISTRICTS AND NEIGHBORHOODS WITH COORDINATES

## Foursquare Data

The next step is to identify most popular venue categories (types) for each neighborhood of NYC and Barcelona. We shall use Foursquare data for this purpose. For coordinates of each neighborhood we shall invoke Foursquare's venues/explore API which returns venues in the round of the given radius around given coordinates.

A sample Foursquare request URL:

```
url =
'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&limit={},{}&radius={}&limit={}'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    lat,
    lng,
    radius,
    LIMIT)
```

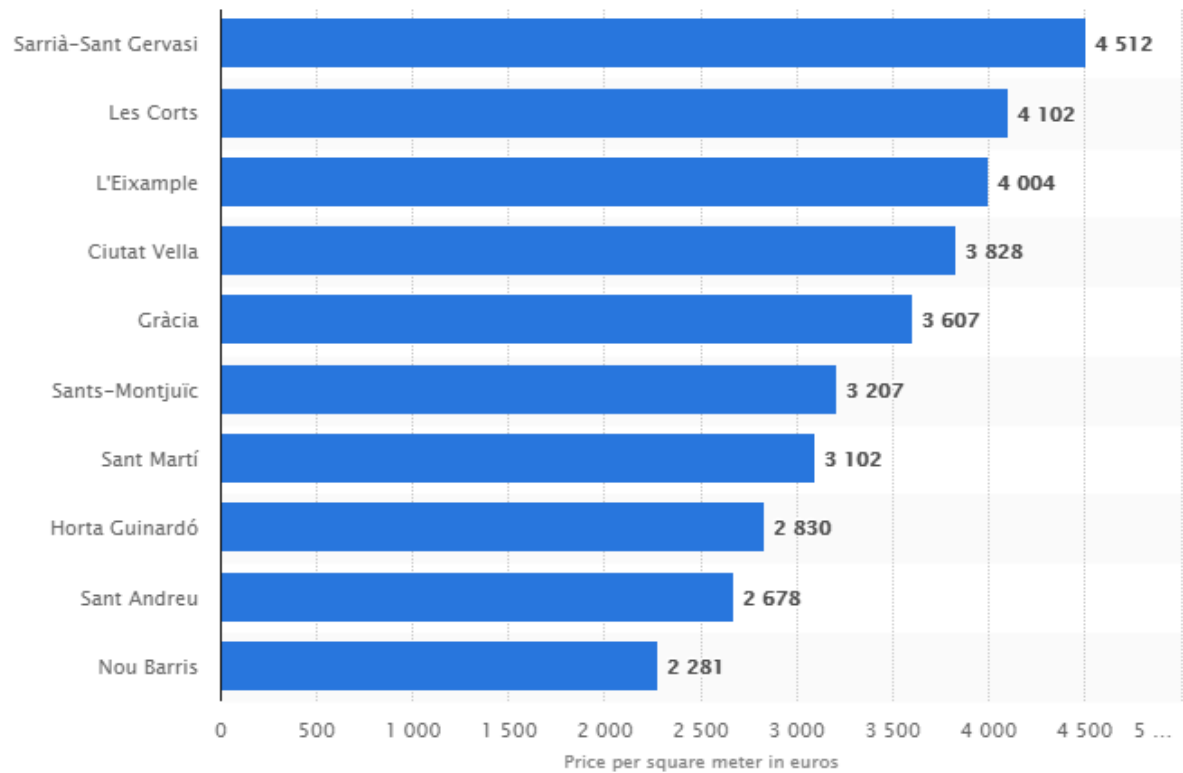
Below is a part of a sample response from the Foursquare API:

```
{'id': '4fa862b3e4b0ebff2f749f06',
 'name': "Harry's Italian Pizza Bar",
 'contact': {'phone': '2126081007', 'formattedPhone': '(212) 608-1007'},
 'location': {'address': '225 Murray St',
 'lat': 40.71521779064671,
 'lng': -74.01473940209351,
 'labeledLatLngs': [{'label': 'display',
 'lat': 40.71521779064671,
 'lng': -74.01473940209351}],
 'postalCode': '10282',
 'cc': 'US',
 'city': 'New York',
 'state': 'NY',
 'country': 'United States',
 'formattedAddress': ['225 Murray St',
 'New York, NY 10282',
 'United States']},
 'canonicalUrl': 'https://foursquare.com/v/harrys-italian-pizza-
bar/4fa862b3e4b0ebff2f749f06',
 'categories': [{'id': '4bf58dd8d48988d1ca941735',
 'name': 'Pizza Place',
 'pluralName': 'Pizza Places',
 'shortName': 'Pizza',
 'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/pizza_',
 'suffix': '.png'},
 'primary': True},
 {'id': '4bf58dd8d48988d110941735',
 'name': 'Italian Restaurant',
 'pluralName': 'Italian Restaurants',
 'shortName': 'Italian',
 'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/italian_',
 'suffix': '.png'}}],
 ...
```

We are interested in the categories section as we will cluster neighborhoods based on frequencies of category venues of neighborhoods.

## Barcelona Property Prices

As we have to propose suitable locations for 2 different offerings (premium and budget), we are interested in property prices (rent or purchase) in Barcelona. Premium coffee shop generates more revenues and can justify a more expensive location, whereas budget coffee shop has to be placed in a cheaper location. A good source of real estate price information is [statista.com](https://www.statista.com) [2] web page. The figure below shows an example of average real estate prices for Q2/2018 for districts of Barcelona.



Data visualized by  + a b l e a u

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**FIGURE 4: REAL ESTATE PRICES IN BARCELONA, BY DISTRICT, Q2/2018**

## Barcelona GeoJSON

For enhanced visualizations we will need a GeoJSON file which determines districts of Barcelona.

GeoJSON is provided by Ajuntament de Barcelona / CartoBCN [3] and can be obtained from

[https://cdn.rawgit.com/martgnz/bcn-geodata/master/barris/barris\\_geo.json](https://cdn.rawgit.com/martgnz/bcn-geodata/master/barris/barris_geo.json).

# Methodology

## Approach

We try to find similar locations in 2 cities: Manhattan, NYC and Barcelona, Spain. Finding similarities between different unlabeled objects with some shared properties implies using an unsupervised machine learning algorithm to cluster objects into clusters. Objects in the same cluster are similar. Inter-cluster distances (measure of (dis)similarity)) are maximized and intra-cluster distances are minimized.

Technically we shall solve the problem by running K-means clustering on neighborhoods of Manhattan and Barcelona.

## Data Processing Pipeline

Data shall be collected, cleaned, merged and enhanced using Foursquare. Before further processing, data shall be visually inspected and verified.

Later processing stages include one-hot encoding of venue categories, grouping and extracting most common venue types by district. This data will be the input for K-means clustering which will determine a cluster label for each neighborhood of Barcelona and Manhattan. The figure below shows a data processing pipeline.

This way, we will be able to find neighborhoods of Manhattan and Barcelona with similar characteristics (i.e. same cluster label) and propose good locations for coffee shop in Barcelona based on NYC data.

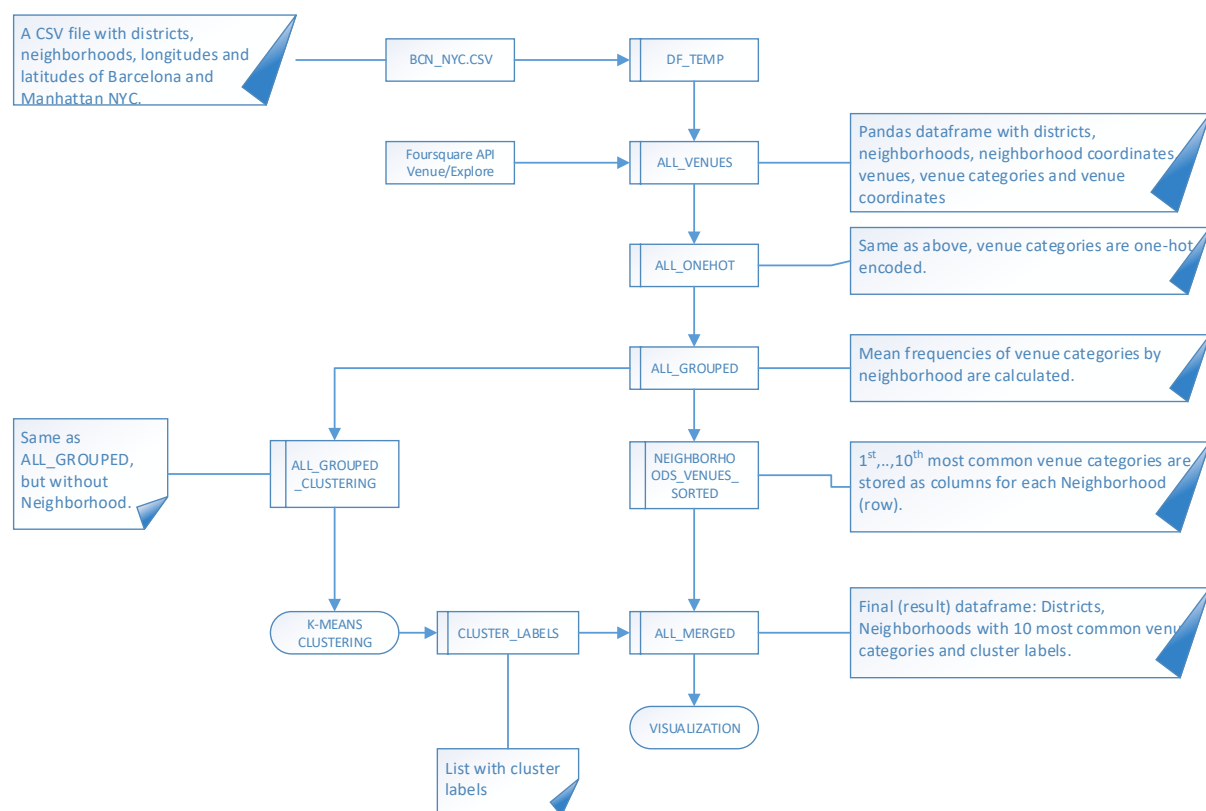
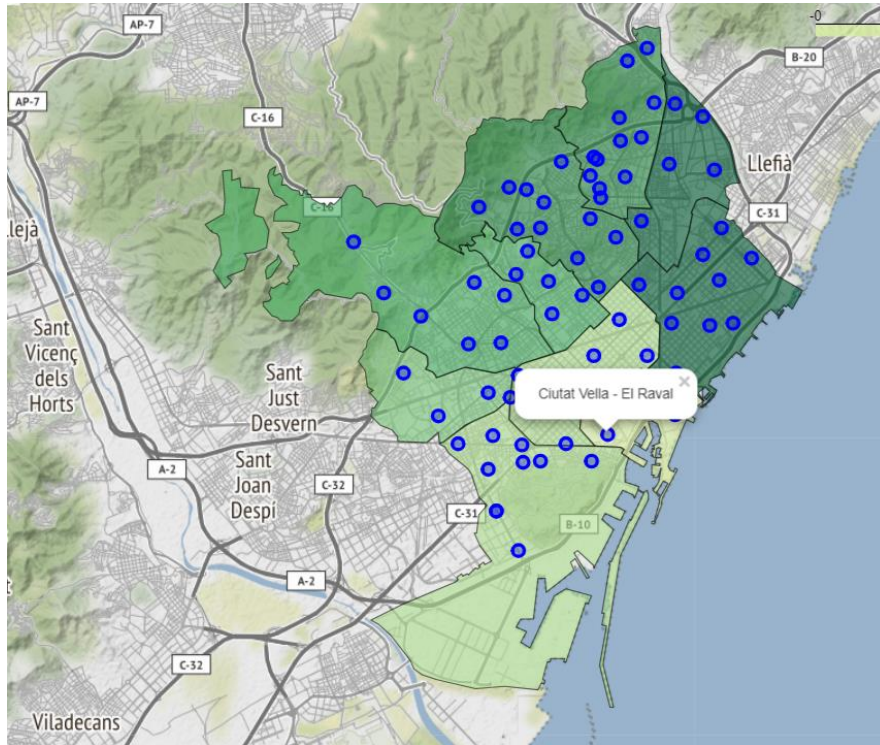


Figure 5: Data processing pipeline



## Data Analysis

After importing the data, first we performed visual inspection. We drew a map of Barcelona, used choropleth to mark districts (10) and blue dot markers to mark neighborhoods (70+). We continued data analysis after making sure all dots were within the city and district labels matched borders as marked by the geojson.

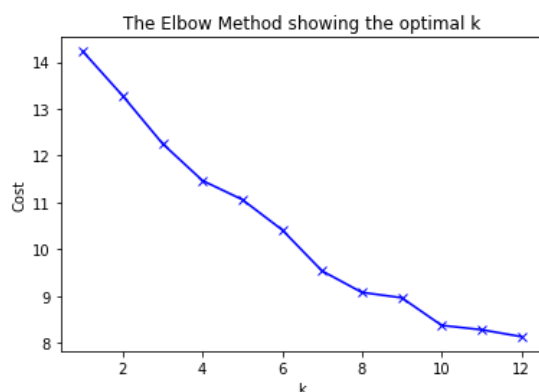


**FIGURE 6: MAP OF BARCELONA WITH MARKED NEIGHBORHOODS; CHOROPLETH REPRESENTS DISTRICTS**

After each data processing step, the shape of the data was checked and data was verified for anomalies (such as NaN values). After preparing the ALL\_GROUPED dataset which served as the main input into clustering, top 5 venues per neighborhood were printed out.

## Finding Best K

An important factor when running K-means cluster is finding the best K. We used the “elbow” method and ran K-means clustering with Ks from 1 to 12. The cost of the model is inertia\_ as returned by the KMeans. We decided 8 was the best K (see figure below).



**FIGURE 7: BEST K VALUE**

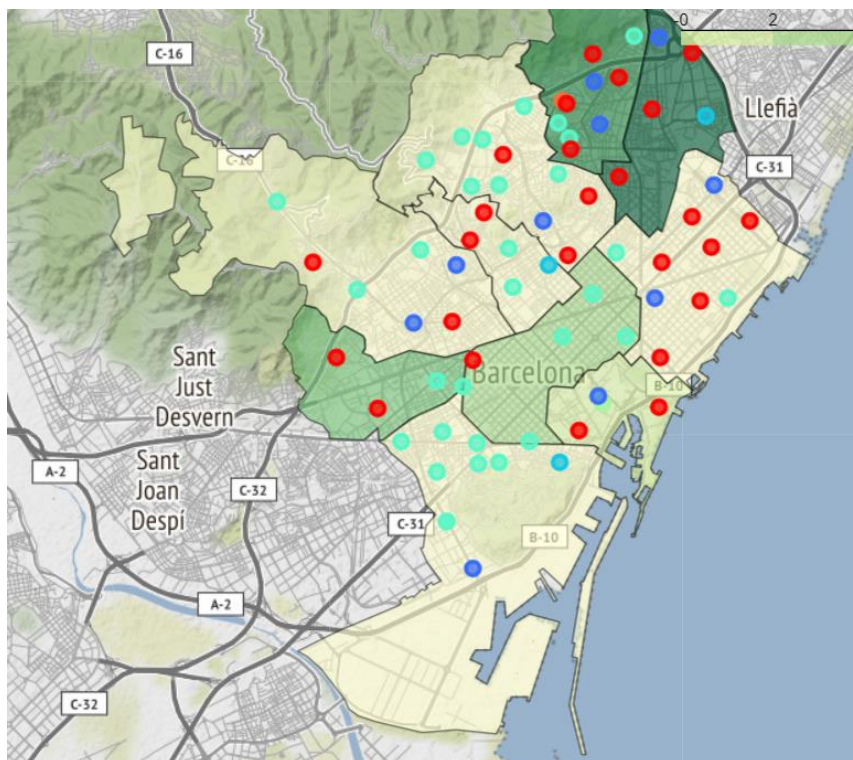
## Clustering

Finally, we ran K-means clustering with K=8. We used sklearn.cluster KMeans implementation. The output was a vector with cluster labels. This vector had to be joined with initial dataset.

## Results

Neighborhoods of Manhattan and Barcelona were clustered into 8 clusters. Some clusters, however, only included Manhattan neighborhood. Barcelona was grouped into 6 distinct clusters. 2 clusters (1, 6) included only Manhattan neighborhoods and 2 clusters (3, 7) included only Barcelona neighborhoods. Those clusters include neighborhoods that do not have counterparts in the other city. 4 clusters, however, included neighborhoods from both cities: clusters 0, 2, 4 and 5.

The figure below shows how Barcelona neighborhoods are clustered.



**FIGURE 8: CLUSTERED NEIGHBORHOODS OF BARCELONA**

The table below shows clusters for each Barcelona district and neighborhood, together with the 3 most common venue categories.

District	Neighborhood	Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
Ciutat Vella	La Barceloneta	0	Mediterranean Restaurant	Bar	Beach
Ciutat Vella	El Gòtic	5	Plaza	Spanish Restaurant	Tapas Restaurant
Ciutat Vella	El Raval	0	Hotel	Tapas Restaurant	Spanish Restaurant
Ciutat Vella	Sant Pere	2	Plaza	Café	Hotel
Ciutat Vella	Santa Caterina i la Ribera	2	Mediterranean Restaurant	Restaurant	Gourmet Shop
Eixample	L'Antiga Esquerra de l'Eixample	0	Italian Restaurant	Restaurant	Hotel
Eixample	La Nova Esquerra de l'Eixample	4	Grocery Store	Food Truck	Coffee Shop
Eixample	Dreta de l'Eixample	4	Hotel	Hostel	Mediterranean Restaurant

Eixample	Fort Pienc	4	Coffee Shop	Café	Park
Eixample	Sagrada Família	4	Café	Tapas Restaurant	Mexican Restaurant
Eixample	Sant Antoni	4	Tapas Restaurant	Mediterranean Restaurant	Bar
Sants-Montjuïc	La Bordeta	4	Bakery	Ramen Restaurant	Food & Drink Shop
Sants-Montjuïc	la Font de la Guatlla	4	Plaza	Spanish Restaurant	Hotel
Sants-Montjuïc	Hostafrancs	4	Pizza Place	Tapas Restaurant	Hotel
Sants-Montjuïc	la Marina de Port	4	Chinese Restaurant	Restaurant	Bakery
Sants-Montjuïc	la Marina del Prat Vermell	4	Chinese Restaurant	Restaurant	Bakery
Sants-Montjuïc	El Poble-sec	3	Tapas Restaurant	Hostel	Pizza Place
Sants-Montjuïc	Sants	4	Bar	Tapas Restaurant	Wine Bar
Sants-Montjuïc	Sants-Badal	4	Pizza Place	Bakery	Hotel
Sants-Montjuïc	Montjuïc	4	Track	Fountain	Art Gallery
Sants-Montjuïc	Zona Franca - Port	2	Gastropub	Spanish Restaurant	Supermarket
Les Corts	les Corts	4	Spanish Restaurant	Japanese Restaurant	Hotel
Les Corts	la Maternitat i Sant Ramon	0	Soccer Field	Soccer Stadium	Sporting Goods Shop
Les Corts	Pedralbes	0	Roof Deck	Hotel	Nightclub
Sarrià-Sant Gervasi	El Putget i Farró	2	Seafood Restaurant	Gym	Multiplex
Sarrià-Sant Gervasi	Sarrià	4	Museum	Plaza	Dog Run
Sarrià-Sant Gervasi	Sant Gervasi - la Bonanova	4	Park	Mediterranean Restaurant	Bookstore
Sarrià-Sant Gervasi	Sant Gervasi - Galvany	0	Italian Restaurant	Liquor Store	Grocery Store
Sarrià-Sant Gervasi	les Tres Torres	2	Hotel	Spanish Restaurant	Restaurant
Sarrià-Sant Gervasi	Vallvidrera	0	Racetrack	Hotel	Yoga Studio
Sarrià-Sant Gervasi	Tibidabo i les Planes	4	Restaurant	Hostel	Pool
Gràcia	Vila de Gràcia	4	Plaza	Café	Bar
Gràcia	el Camp d'en Grassot i Gràcia Nova	3	Bar	Café	Bakery
Gràcia	la Salut	4	Sandwich Place	Historic Site	Mountain
Gràcia	el Coll	0	Hotel	Mediterranean Restaurant	Park
Gràcia	Vallcarca i els Penitents	0	Bakery	Pool	Café
Horta-Guinardó	El Baix Guinardó	0	Japanese Restaurant	Breakfast Spot	Grocery Store
Horta-Guinardó	El Guinardó	0	Grocery Store	Plaza	Restaurant
Horta-Guinardó	Can Baró	2	Chinese Restaurant	Grocery Store	Department Store
Horta-Guinardó	El Carmel	4	Food Court	Park	Garden
Horta-Guinardó	la Font d'en Fargues	4	Food & Drink Shop	Gym / Fitness Center	Restaurant
Horta-Guinardó	Horta	4	Metro Station	Yoga Studio	Field
Horta-Guinardó	la Clota	0	Museum	Hostel	Park
Horta-Guinardó	Montbau	4	Park	Plaza	Breakfast Spot
Horta-Guinardó	Sant Genís dels Agudells	4	Music Venue	Soccer Field	Field
Horta-Guinardó	la Teixonera	4	Spanish Restaurant	Bar	Mediterranean Restaurant
Horta-Guinardó	La Vall d'Hebron	4	Mediterranean Restaurant	Bakery	Restaurant
Nou Barris	Can Peguera	4	Park	Yoga Studio	Empanada Restaurant
Nou Barris	Canyelles	7	Grocery Store	Seafood Restaurant	Food & Drink Shop
Nou Barris	Ciutat Meridiana	0	Park	Train Station	Plaza
Nou Barris	La Guineueta	0	Grocery Store	Seafood Restaurant	Café
Nou Barris	Porta	2	Public Art	Supermarket	Plaza

Nou Barris	La Prosperitat	0	Park	Spanish Restaurant	Italian Restaurant
Nou Barris	les Roquetes	0	Gym	Plaza	Gym Pool
Nou Barris	la Trinitat Nova	4	Restaurant	Metro Station	Bar
Nou Barris	El Turó de la Peira	4	Grocery Store	Breakfast Spot	Hot Dog Joint
Nou Barris	Vallbona	4	Bus Stop	Plaza	Yoga Studio
Nou Barris	Verdum	2	Spanish Restaurant	Grocery Store	Brewery
Nou Barris	Vilapicina i la Torre Llobeta	0	Bar	Breakfast Spot	Supermarket
Sant Andreu	Baró de Viver	0	Bakery	Gift Shop	Plaza
Sant Andreu	Bon Pastor	3	Café	Brewery	Bar
Sant Andreu	El Congrés i els Indians	0	Tapas Restaurant	Gym / Fitness Center	Plaza
Sant Andreu	Navas	2	Breakfast Spot	Spanish Restaurant	Mediterranean Restaurant
Sant Andreu	Sant Andreu de Palomar	0	Plaza	Tapas Restaurant	Bar
Sant Andreu	La Sagrera i Trinitat Vella	2	Spanish Restaurant	Soccer Field	Metro Station
Sant Martí	El Besòs i el Maresme	0	Bakery	Bar	Climbing Gym
Sant Martí	el Clot	0	Tapas Restaurant	Mediterranean Restaurant	Spanish Restaurant
Sant Martí	El Camp de l'Arpa del Clot	4	Bakery	Burger Joint	Restaurant
Sant Martí	Diagonal Mar i el Front Marítim del Poblenou	4	Restaurant	Spanish Restaurant	Plaza
Sant Martí	el Parc i la Llacuna del Poblenou	2	Hotel	Spanish Restaurant	Clothing Store
Sant Martí	Poblenou	0	Mediterranean Restaurant	Restaurant	Café
Sant Martí	Provençals del Poblenou	0	Liquor Store	Wine Bar	Tennis Court
Sant Martí	Sant Martí de Provençals	0	Soccer Field	Pizza Place	Auto Dealership
Sant Martí	La Verneda i la Pau	2	Bakery	Supermarket	Falafel Restaurant
Sant Martí	la Vila Olímpica del Poblenou	0	Café	Hotel	Burger Joint

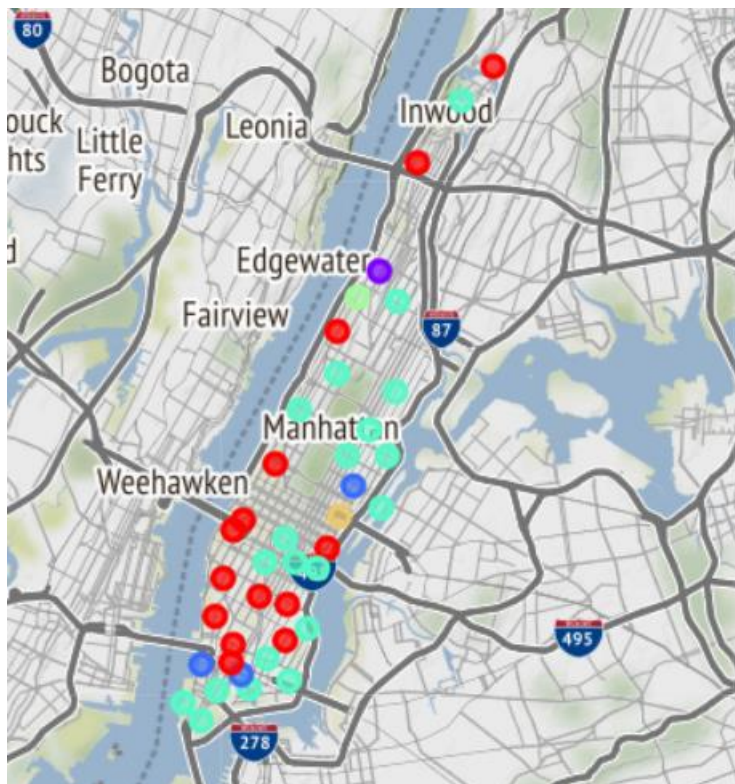


FIGURE 9: CLUSTERED NEIGHBORHOODS OF MANHATTAN, NYC

Now let us compare Manhattan neighborhoods with Barcelona neighborhoods. There are 4 clusters with neighborhoods from both cities.

District	Neighborhood	Cluster	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
Manhattan	Marble Hill	0	Bank	Train Station	Shoe Store
Manhattan	Washington Heights	0	Café	Chinese Restaurant	Mobile Phone Shop
Manhattan	Lincoln Square	0	Theater	Concert Hall	Plaza
Manhattan	Clinton	0	Theater	Restaurant	Wine Shop
Manhattan	Chelsea	0	Nightclub	Ice Cream Shop	Hotel
Manhattan	Greenwich Village	0	Italian Restaurant	Clothing Store	Cosmetics Shop
Manhattan	East Village	0	Bar	Ice Cream Shop	Wine Bar
Manhattan	Soho	0	Clothing Store	Women's Store	Boutique
Manhattan	West Village	0	Italian Restaurant	Cosmetics Shop	Gastropub
Manhattan	Morningside Heights	0	Food Truck	Sandwich Place	Greek Restaurant
Manhattan	Gramercy	0	Thrift / Vintage Store	Coffee Shop	Wine Shop
Manhattan	Turtle Bay	0	Café	Noodle House	Italian Restaurant
Manhattan	Flatiron	0	Yoga Studio	Italian Restaurant	American Restaurant
Manhattan	Hudson Yards	0	Coffee Shop	Café	Art Gallery
Ciutat Vella	La Barceloneta	0	Mediterranean Restaurant	Bar	Beach
Ciutat Vella	El Raval	0	Hotel	Tapas Restaurant	Spanish Restaurant
Eixample	L'Antiga Esquerra de l'Eixample	0	Italian Restaurant	Restaurant	Hotel
Les Corts	la Maternitat i Sant Ramon	0	Soccer Field	Soccer Stadium	Sporting Goods Shop
Les Corts	Pedralbes	0	Roof Deck	Hotel	Nightclub
Sarrià-Sant Gervasi	Sant Gervasi - Galvany	0	Italian Restaurant	Liquor Store	Grocery Store
Sarrià-Sant Gervasi	Vallvidrera	0	Racetrack	Hotel	Yoga Studio
Gràcia	el Coll	0	Hotel	Mediterranean Restaurant	Park
Gràcia	Vallcarca i els Penitents	0	Bakery	Pool	Café
Horta-Guinardó	El Baix Guinardó	0	Japanese Restaurant	Breakfast Spot	Grocery Store
Horta-Guinardó	El Guinardó	0	Grocery Store	Plaza	Restaurant
Horta-Guinardó	la Clota	0	Museum	Hostel	Park
Nou Barris	Ciutat Meridiana	0	Park	Train Station	Plaza
Nou Barris	La Guineueta	0	Grocery Store	Seafood Restaurant	Café
Nou Barris	La Prosperitat	0	Park	Spanish Restaurant	Italian Restaurant
Nou Barris	les Roquetes	0	Gym	Plaza	Gym Pool
Nou Barris	Vilapicina i la Torre Llobeta	0	Bar	Breakfast Spot	Supermarket
Sant Andreu	Baró de Viver	0	Bakery	Gift Shop	Plaza
Sant Andreu	El Congrés i els Indians	0	Tapas Restaurant	Gym / Fitness Center	Plaza
Sant Andreu	Sant Andreu de Palomar	0	Plaza	Tapas Restaurant	Bar
Sant Martí	El Besòs i el Maresme	0	Bakery	Bar	Climbing Gym
Sant Martí	el Clot	0	Tapas Restaurant	Mediterranean Restaurant	Spanish Restaurant
Sant Martí	Poblenou	0	Mediterranean Restaurant	Restaurant	Café
Sant Martí	Provençals del Poblenou	0	Liquor Store	Wine Bar	Tennis Court
Sant Martí	Sant Martí de Provençals	0	Soccer Field	Pizza Place	Auto Dealership
Sant Martí	la Vila Olímpica del Poblenou	0	Café	Hotel	Burger Joint
Manhattan	Lenox Hill	2	Coffee Shop	Pizza Place	Gift Shop
Manhattan	Tribeca	2	American Restaurant	Greek Restaurant	Spa
Manhattan	Little Italy	2	Bakery	Coffee Shop	Café

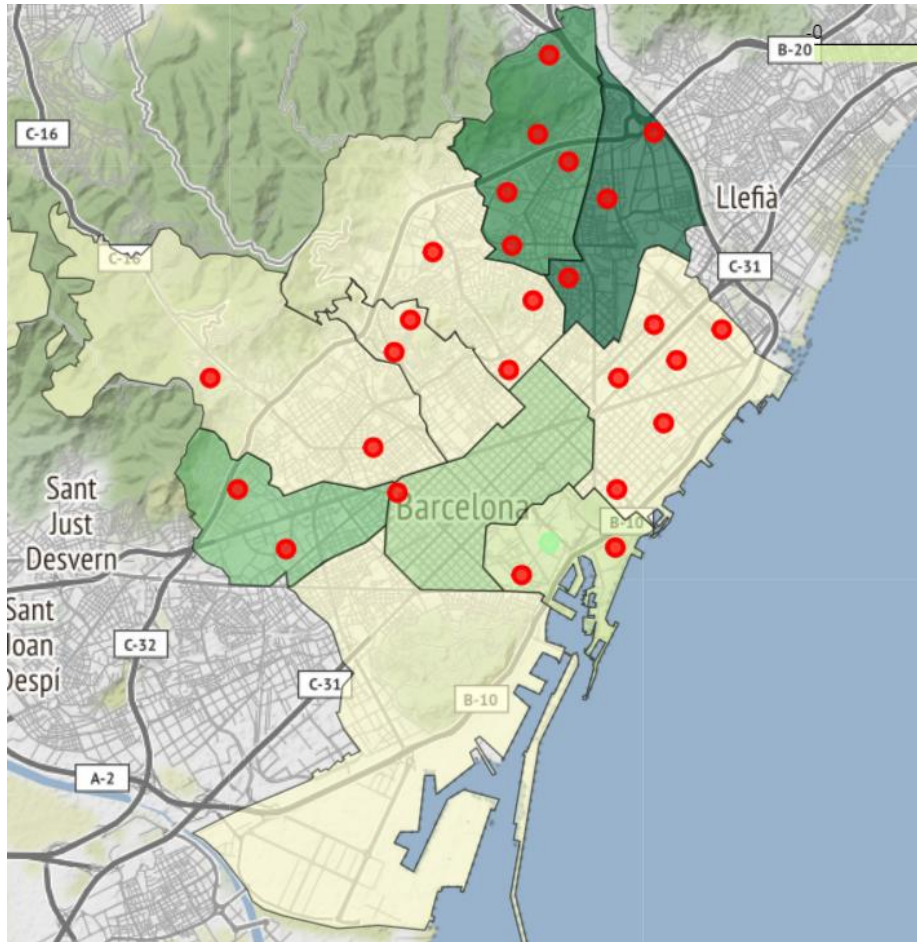
Ciutat Vella	Sant Pere	2	Plaza	Café	Hotel
Ciutat Vella	Santa Caterina i la Ribera	2	Mediterranean Restaurant	Restaurant	Gourmet Shop
Sants-Montjuïc	Zona Franca - Port	2	Gastropub	Spanish Restaurant	Supermarket
Sarrià-Sant Gervasi	El Putget i Farró	2	Seafood Restaurant	Gym	Multiplex
Sarrià-Sant Gervasi	les Tres Torres	2	Hotel	Spanish Restaurant	Restaurant
Horta-Guinardó	Can Baró	2	Chinese Restaurant	Grocery Store	Department Store
Nou Barris	Porta	2	Public Art	Supermarket	Plaza
Nou Barris	Verdum	2	Spanish Restaurant	Grocery Store	Brewery
Sant Andreu	Navas	2	Breakfast Spot	Spanish Restaurant	Mediterranean Restaurant
Sant Andreu	La Sagrera i Trinitat Vella	2	Spanish Restaurant	Soccer Field	Metro Station
Sant Martí	el Parc i la Llacuna del Poblenou	2	Hotel	Spanish Restaurant	Clothing Store
Sant Martí	La Verneda i la Pau	2	Bakery	Supermarket	Falafel Restaurant
Manhattan	Chinatown	4	Bubble Tea Shop	Vietnamese Restaurant	Chinese Restaurant
Manhattan	Inwood	4	Café	Bakery	Frozen Yogurt Shop
Manhattan	Central Harlem	4	Fried Chicken Joint	African Restaurant	Caribbean Restaurant
Manhattan	East Harlem	4	Latin American Restaurant	Mexican Restaurant	French Restaurant
Manhattan	Upper East Side	4	Art Gallery	Italian Restaurant	Hotel
Manhattan	Yorkville	4	Sushi Restaurant	Italian Restaurant	Coffee Shop
Manhattan	Roosevelt Island	4	Liquor Store	Supermarket	School
Manhattan	Upper West Side	4	Burger Joint	American Restaurant	Italian Restaurant
Manhattan	Midtown	4	Hotel	Steakhouse	Coffee Shop
Manhattan	Murray Hill	4	Hotel	Bar	Bagel Shop
Manhattan	Lower East Side	4	Yoga Studio	Supermarket	Deli / Bodega
Manhattan	Manhattan Valley	4	Deli / Bodega	Italian Restaurant	Indian Restaurant
Manhattan	Battery Park City	4	Park	Cupcake Shop	Food Court
Manhattan	Financial District	4	Coffee Shop	Steakhouse	Juice Bar
Manhattan	Carnegie Hill	4	Café	Bar	Gym
Manhattan	Noho	4	Italian Restaurant	Coffee Shop	Hotel
Manhattan	Civic Center	4	Gym	Italian Restaurant	Gym / Fitness Center
Manhattan	Midtown South	4	Korean Restaurant	Coffee Shop	Cosmetics Shop
Manhattan	Tudor City	4	Park	Deli / Bodega	Garden
Manhattan	Stuyvesant Town	4	Playground	Baseball Field	Park
Eixample	La Nova Esquerra de l'Eixample	4	Grocery Store	Food Truck	Coffee Shop
Eixample	Dreta de l'Eixample	4	Hotel	Hostel	Mediterranean Restaurant
Eixample	Fort Pienc	4	Coffee Shop	Café	Park
Eixample	Sagrada Família	4	Café	Tapas Restaurant	Mexican Restaurant
Eixample	Sant Antoni	4	Tapas Restaurant	Mediterranean Restaurant	Bar
Sants-Montjuïc	La Bordeta	4	Bakery	Ramen Restaurant	Food & Drink Shop
Sants-Montjuïc	la Font de la Guatlà	4	Plaza	Spanish Restaurant	Hotel
Sants-Montjuïc	Hostafrancs	4	Pizza Place	Tapas Restaurant	Hotel
Sants-Montjuïc	la Marina de Port	4	Chinese Restaurant	Restaurant	Bakery
Sants-Montjuïc	la Marina del Prat Vermell	4	Chinese Restaurant	Restaurant	Bakery
Sants-Montjuïc	Sants	4	Bar	Tapas Restaurant	Wine Bar
Sants-Montjuïc	Sants-Badal	4	Pizza Place	Bakery	Hotel
Sants-Montjuïc	Montjuïc	4	Track	Fountain	Art Gallery



Les Corts	les Corts	4	Spanish Restaurant	Japanese Restaurant	Hotel
Sarrià-Sant Gervasi	Sarrià	4	Museum	Plaza	Dog Run
Sarrià-Sant Gervasi	Sant Gervasi - la Bonanova	4	Park	Mediterranean Restaurant	Bookstore
Sarrià-Sant Gervasi	Tibidabo i les Planes	4	Restaurant	Hostel	Pool
Gràcia	Vila de Gràcia	4	Plaza	Café	Bar
Gràcia	la Salut	4	Sandwich Place	Historic Site	Mountain
Horta-Guinardó	El Carmel	4	Food Court	Park	Garden
Horta-Guinardó	la Font d'en Fargues	4	Food & Drink Shop	Gym / Fitness Center	Restaurant
Horta-Guinardó	Horta	4	Metro Station	Yoga Studio	Field
Horta-Guinardó	Montbau	4	Park	Plaza	Breakfast Spot
Horta-Guinardó	Sant Genís dels Agudells	4	Music Venue	Soccer Field	Field
Horta-Guinardó	la Teixonera	4	Spanish Restaurant	Bar	Mediterranean Restaurant
Horta-Guinardó	La Vall d'Hebron	4	Mediterranean Restaurant	Bakery	Restaurant
Nou Barris	Can Peguera	4	Park	Yoga Studio	Empanada Restaurant
Nou Barris	la Trinitat Nova	4	Restaurant	Metro Station	Bar
Nou Barris	El Turó de la Peira	4	Grocery Store	Breakfast Spot	Hot Dog Joint
Nou Barris	Vallbona	4	Bus Stop	Plaza	Yoga Studio
Sant Martí	El Camp de l'Arpa del Clot	4	Bakery	Burger Joint	Restaurant
Sant Martí	Diagonal Mar i el Front Marítim del Poblenou	4	Restaurant	Spanish Restaurant	Plaza
Manhattan	Manhattanville	5	Bar	Asian Restaurant	Bus Station
Ciutat Vella	El Gòtic	5	Plaza	Spanish Restaurant	Tapas Restaurant

## Discussion

Our initial assumption was that the best performing locations in Manhattan were Gramercy, Turtle Bay, Little Italy, East Village, and Manhattanville. Our analysis showed that Gramercy, Turtle Bay, and East Village belong to the cluster 0. Therefore, a good location for a coffee shop in Barcelona would also be in cluster 0. An interesting spot is Manhattanville which belongs to the cluster 5. This cluster includes exactly 2 neighborhoods: Manhattanville in NYC and El Gotic in Barcelona. This will be our second recommendation.



**FIGURE 10: RECOMMENDED NEIGHBORHOODS FOR A COFFEE SHOP IN BARCELONA; RED DOTS REPRESENT CLUSTER 0 AND GREEN DOT REPRESENTS CLUSTER 5**

Additionally, business required 2 types of recommendations: for a budget-oriented café and for a premium-oriented café. Based on real estate prices of Barcelona districts, we can recommend locations for budget café in one of the cheaper districts, for example Nou Baris or Sant Andreu. On the other hand, the premium café requires the best location in the city, so our recommendation will be to look for a district in a pricier district, such as Ciutat Vella, Eixample, Sarrià-Sant Gervasi, or Gràcia.

The table below shows all possible neighborhoods with top 3 venue categories.

District	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	Price
Ciutat Vella	La Barceloneta	Mediterranean Restaurant	Bar	Beach	High
Ciutat Vella	El Gòtic	Plaza	Spanish Restaurant	Tapas Restaurant	High
Ciutat Vella	El Raval	Hotel	Tapas Restaurant	Spanish Restaurant	High
Eixample	L'Antiga Esquerra de l'Eixample	Italian Restaurant	Restaurant	Hotel	High
Les Corts	la Maternitat i Sant Ramon	Soccer Field	Soccer Stadium	Sporting Goods Shop	High
Les Corts	Pedralbes	Roof Deck	Hotel	Nightclub	High
Sarrià-Sant Gervasi	Sant Gervasi - Galvany	Italian Restaurant	Liquor Store	Grocery Store	High
Sarrià-Sant Gervasi	Vallvidrera	Racetrack	Hotel	Yoga Studio	High
Gràcia	el Coll	Hotel	Mediterranean Restaurant	Park	High



Gràcia	Vallcarca i els Penitents	Bakery	Pool	Café	High
Horta-Guinardó	El Baix Guinardó	Japanese Restaurant	Breakfast Spot	Grocery Store	Low
Horta-Guinardó	El Guinardó	Grocery Store	Plaza	Restaurant	Low
Horta-Guinardó	la Clota	Museum	Hostel	Park	Low
Nou Barris	Ciutat Meridiana	Park	Train Station	Plaza	Low
Nou Barris	La Guineueta	Grocery Store	Seafood Restaurant	Café	Low
Nou Barris	La Prosperitat	Park	Spanish Restaurant	Italian Restaurant	Low
Nou Barris	les Roquetes	Gym	Plaza	Gym Pool	Low
Nou Barris	Vilapicina i la Torre Llobeta	Bar	Breakfast Spot	Supermarket	Low
Sant Andreu	Baró de Viver	Bakery	Gift Shop	Plaza	Low
Sant Andreu	El Congrés i els Indians	Tapas Restaurant	Gym / Fitness Center	Plaza	Low
Sant Andreu	Sant Andreu de Palomar	Plaza	Tapas Restaurant	Bar	Low
Sant Martí	El Besòs i el Maresme	Bakery	Bar	Climbing Gym	Medium
Sant Martí	el Clot	Tapas Restaurant	Mediterranean Restaurant	Spanish Restaurant	Medium
Sant Martí	Poblenou	Mediterranean Restaurant	Restaurant	Café	Medium
Sant Martí	Provençals del Poblenou	Liquor Store	Wine Bar	Tennis Court	Medium
Sant Martí	Sant Martí de Provençals	Soccer Field	Pizza Place	Auto Dealership	Medium
Sant Martí	la Vila Olímpica del Poblenou	Café	Hotel	Burger Joint	Medium

Based on price and proximity to well-known sites in Barcelona, we can narrow-down our recommendations.

Premium café location recommendation:

District	Neighborhood	Cluster
Ciutat Vella	La Barceloneta	0
Ciutat Vella	El Gòtic	5
Ciutat Vella	El Raval	0
Eixample	L'Antiga Esquerra de l'Eixample	0
Sarrià-Sant Gervasi	Sant Gervasi - Galvany	0
Sarrià-Sant Gervasi	Vallvidrera	0
Gràcia	el Coll	0
Gràcia	Vallcarca i els Penitents	0

Budget-café location recommendation:

District	Neighborhood	Cluster
Nou Barris	Ciutat Meridiana	0
Nou Barris	La Guineueta	0
Nou Barris	La Prosperitat	0
Nou Barris	les Roquetes	0
Nou Barris	Vilapicina i la Torre Llobeta	0
Sant Andreu	Baró de Viver	0
Sant Andreu	El Congrés i els Indians	0
Sant Andreu	Sant Andreu de Palomar	0

## Conclusion

The analysis analyzed neighborhoods of Manhattan, NYC and Barcelona, Spain. Based on frequency of venue categories of both cities, we created clusters of similar neighborhoods of both cities. As performance data (profitability, customer satisfaction) was available for NYC locations, we were able to predict which locations would be good performers in Barcelona.

We recommended 2 types of locations: for the company's premium offering we recommended pricier locations with similar characteristics to best performing NYC locations. For the budget offering we recommended cheaper locations, however these locations share characteristics with NYC best performing locations.

Another use-case of this analysis could be to find cheaper locations in Barcelona that share characteristics with the most expensive location. For example, if in the future business decides to relocate their coffee shop from a location that became too expensive to a cheaper location.

## References

- [1] [https://en.wikipedia.org/wiki/Districts\\_of\\_Barcelona](https://en.wikipedia.org/wiki/Districts_of_Barcelona)
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## Appendix A: Districts & Neighborhoods of Barcelona and Manhattan

	District_ID	District	Neighborhood	Latitude	Longitude
0,0	Manhattan	Marble Hill	40.87655077879964,-73.91065965862981		
1,0	Manhattan	Chinatown	40.71561842231432,-73.99427936255978		
2,0	Manhattan	Washington Heights	40.85190252555305,-73.93690027985234		
3,0	Manhattan	Inwood	40.86768396449915,-73.92121042203897		
4,0	Manhattan	Hamilton Heights	40.823604284811935,-73.94968791883366		
5,0	Manhattan	Manhattanville	40.8169344294978,-73.9573853935188		
6,0	Manhattan	Central Harlem	40.81597606742414,-73.94321112603905		
7,0	Manhattan	East Harlem	40.79224946663033,-73.94418223148524		
8,0	Manhattan	Upper East Side	40.775638573301805,-73.96050763135		
9,0	Manhattan	Yorkville	40.775929849884875,-73.94711784471826		
10,0	Manhattan	Lenox Hill	40.76811265828733,-73.9588596881376		
11,0	Manhattan	Roosevelt Island	40.76215960576283,-73.94916769227953		
12,0	Manhattan	Upper West Side	40.787657998534854,-73.97705923630603		
13,0	Manhattan	Lincoln Square	40.77352888942166,-73.98533777001262		
14,0	Manhattan	Clinton	40.75910089146212,-73.99611936309479		
15,0	Manhattan	Midtown	40.75469110270623,-73.98166882730304		
16,0	Manhattan	Murray Hill	40.748303077252174,-73.97833207924127		
17,0	Manhattan	Chelsea	40.744034706747975,-74.00311633472813		
18,0	Manhattan	Greenwich Village	40.72693288536128,-73.99991402945902		
19,0	Manhattan	East Village	40.727846777270244,-73.98222616506416		
20,0	Manhattan	Lower East Side	40.71780674892765,-73.98089031999291		
21,0	Manhattan	Tribeca	40.721521967443216,-74.01068328559087		
22,0	Manhattan	Little Italy	40.71932379395907,-73.99730467208073		
23,0	Manhattan	Soho	40.72218384131794,-74.00065666959759		
24,0	Manhattan	West Village	40.73443393572434,-74.00617998126812		
25,0	Manhattan	Manhattan Valley	40.797307041702865,-73.96428617740655		
26,0	Manhattan	Morningside Heights	40.807999738165826,-73.96389627905332		
27,0	Manhattan	Gramercy	40.737209832715,-73.98137594833541		
28,0	Manhattan	Battery Park City	40.71193198394565,-74.01686930508617		
29,0	Manhattan	Financial District	40.70710710727048,-74.0106654452127		
30,0	Manhattan	Carnegie Hill	40.7826825671257,-73.95325646837112		
31,0	Manhattan	Noho	40.72325901885768,-73.98843368023597		
32,0	Manhattan	Civic Center	40.71522892046282,-74.00541529873355		
33,0	Manhattan	Midtown South	40.7485096643122,-73.98871313285247		
34,0	Manhattan	Sutton Place	40.76028033131374,-73.96355614094303		
35,0	Manhattan	Turtle Bay	40.75204236950722,-73.96770824581834		
36,0	Manhattan	Tudor City	40.746917410740195,-73.97121928722265		
37,0	Manhattan	Stuyvesant Town	40.73099955477061,-73.97405170469203		
38,0	Manhattan	Flatiron	40.739673047638426,-73.9909471052826		
39,0	Manhattan	Hudson Yards	40.75665808227519,-74.00011136202637		
40,1	Ciutat Vella	La Barceloneta	41.38185000000004,2.1915100000000507		
41,1	Ciutat Vella	El G��tic	41.38280000000003,2.1772700000000214		
42,1	Ciutat Vella	El Raval	41.377630000000007,2.171450000000005		
43,1	Ciutat Vella	Sant Pere	41.3840967969,2.17629596148		
44,1	Ciutat Vella	Santa Caterina i la Ribera	42.283900000000074,2.018920000000037		
45,2	Eixample	L'Antiga Esquerra de l'Eixample	41.390690000000006,2.1449400000000196		
46,2	Eixample	La Nova Esquerra de l'Eixample	41.385710000000074,2.1425400000000536		
47,2	Eixample	Dreta de l'Eixample	41.394980000000003,2.16748000000000687		
48,2	Eixample	Fort Pienc	41.395190000000007,2.18307000000000434		
49,2	Eixample	Sagrada Fam��lia	41.40315001832192,2.174899956142963		
50,2	Eixample	Sant Antoni	41.375640000000003,2.1592300000000364		
51,3	Sants-Montju��c	La Bordeta	41.369860000000074,2.1362200000000037		
52,3	Sants-Montju��c	la Font de la Guatlla	41.371310000000005,2.1464500000000726		
53,3	Sants-Montju��c	Hostafrancs	41.375220000000007,2.1459700000000034		
54,3	Sants-Montju��c	la Marina de Port	41.360450000000007,2.1384700000000407		
55,3	Sants-Montju��c	la Marina del Prat Vermell	41.360450000000007,2.1384700000000407		
56,3	Sants-Montju��c	El Poble-sec	41.371750000000008,2.1666800000000042		
57,3	Sants-Montju��c	Sants	41.377200000000007,2.1376000000000204		
58,3	Sants-Montju��c	Sants-Badal	41.375610000000005,2.1273000000000048		
59,3	Sants-Montju��c	Montju��c	41.371720000000004,2.15157000000000493		
60,3	Sants-Montju��c	Zona Franca - Port	41.35186761513899,2.1449695333004715		

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62,4,Les Corts,la Maternitat i Sant Ramon,41.381680000000074,2.121370000000007  
63,4,Les Corts,Pedralbes,41.391230000000064,2.1111100000000533  
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65,5,SarriÀ -Sant Gervasi,SarriÀ ,41.40375000000006,2.1160900000000424  
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69,5,SarriÀ -Sant Gervasi,Vallvidrera,41.408998364,2.105166246  
70,5,SarriÀ -Sant Gervasi,Tibidabo i les Planes,41.42036000000007,2.096240000000023  
71,6,GrÀ cia,Vila de GrÀ cia,41.404450000000054,2.155050000000074  
72,6,GrÀ cia,el Camp d'en Grassot i GrÀ cia  
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73,6,GrÀ cia,la Salut,41.411550000000034,2.154070000000047  
74,6,GrÀ cia,el Coll,41.41818000000006,2.1478000000000748  
75,6,GrÀ cia,Vallcarca i els Penitents,41.41324000000003,2.144550000000038  
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78,7,Horta-GuinardÀ³,Can BarÀ³,41.41665000000006,2.1625300000000607  
79,7,Horta-GuinardÀ³,El Carmel,41.42352000000005,2.151740000000075  
80,7,Horta-GuinardÀ³,la Font d'en Fargues,41.42548000000005,2.1664100000000417  
81,7,Horta-GuinardÀ³,Horta,41.43820000000005,2.157950000000028  
82,7,Horta-GuinardÀ³,la Clota,41.42912000000007,2.152680000000032  
83,7,Horta-GuinardÀ³,Montbau,41.432510000000036,2.1423000000000343  
84,7,Horta-GuinardÀ³,Sant GenÀ-s dels Agudells,41.42802000000006,2.133480000000002  
85,7,Horta-GuinardÀ³,la Teixonera,41.42307000000005,2.1448200000000384  
86,7,Horta-GuinardÀ³,La Vall d'Hebron,41.43200000000007,2.147480000000003  
87,8,Nou Barris,Can Peguera,41.43508000000003,2.166530000000023  
88,8,Nou Barris,Canyelles,41.438998244,2.167332664  
89,8,Nou Barris,Ciutat Meridiana,41.46038000000004,2.1772300000000655  
90,8,Nou Barris,La Guineueta,41.43859000000003,2.168290000000007  
91,8,Nou Barris,Porta,41.43480000000005,2.1767600000000584  
92,8,Nou Barris,La Prosperitat,41.44353000000007,2.1816400000000726  
93,8,Nou Barris,les Roquetes,41.44787000000008,2.175070000000062  
94,8,Nou Barris,la Trinitat Nova,41.45112000000006,2.185320000000047  
95,8,Nou Barris,El TurÀ³ de la Peira,41.432150000000036,2.1690300000000207  
96,8,Nou Barris,Vallbona,41.46342000000004,2.1831300000000624  
97,8,Nou Barris,Verdum,41.442810000000065,2.1753100000000245  
98,8,Nou Barris,Vilapicina i la Torre Llobeta,41.430030000000045,2.1693800000000465  
99,9,Sant Andreu,BarÀ³ de Viver,41.44804000000005,2.199630000000007  
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101,9,Sant Andreu,El Congràs i els Indians,41.42492000000004,2.181470000000047  
102,9,Sant Andreu,Navas,41.900030000000007,1.8783800000000497  
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107,10,Sant MartÀ-,El Camp de l'Arpa del Clot,41.41068000000007,2.1806300000000647  
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