# Kyiv's Best Locations Analysis for a New Venue Opening

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## 1.    Description and Discussion of the Background

Kyiv, a capital of Ukraine is middle-sized European city with population of about 3 mln. people and average population density of 3 299 people per square kilometer. There are 10 Administrative Divisions in Kyiv that we'll consider.

For last several years, Kyiv HoReCa segment has been growing very fast. Currently Kyiv central areas are fulfilled with restaurants and coffeeshops, new venues are to be opened every day, so the market in general is still in positive dynamics.

At the same time, residential areas far from city center are yet feel the lack of the venues to socialize and have a rest. An entrance level to open a new restaurant there is still rather low instead of city center with its uprising rent rates and high concentration of venues.

Therefore, to find a proper location with low rent and a stable flow of consumers in the non-center Boroughs with the highest development potential is a question to define in a further research. To make a decision on the location of a new venue to be opened the vendor has to consider all the aspects of surrounding environment – rent rates, neighborhood population density, demographics, nearby venues and sightseeing.

So, our analysis is addressed to the vendors looking for the best locations to open a new venue – restaurant or coffee shop.

## 2. Data Description

To solve the problem we have to explore the Boroughs using open data sources:

- Administrative Divisions of Kyiv city downloaded from Github. The .json file has coordinates of all Kyiv districts (Boroughs). In further we'll use it to create a choropleth map of Kyiv property values.
- Forsquare API to get the venues (restaurants and coffee shops in particular)  of given Kyiv Boroughs.
- Actual Kyiv primary commercial property market prices from realt.ua - average for each Borough – for the lack of affordable online information on commercial property rent rates, we'll use it to create a choropleth map of Kyiv commercial property values.
- Previously prepared and downloaded xslx. file to get the center coordinates of the each Borough.
- Kyiv Wikipedia page to get data on Boroughs population density.

## 3. Methodology

My master Data Frame consist of all necessary data grabbed from different sources and joint together in the columns:

- Borough
- Population Density
- Commercial Property Price

```
141]: Kyiv_com_prop
```

141]:

| | Distr | District | Price UAH per sq m | Density(people on 1 km$^2$) |
|---|---|---|---|---|
| 0 | Holosiivskyi district | Holosiivskyi | 26876 | 1301 |
| 1 | Darnytskyi district | Darnytskyi | 17913 | 2107 |
| 2 | Desnianskyi district | Desnianskyi | 30000 | 2272 |
| 3 | Obolonskyi district | Obolonskyi | 15360 | 2783 |
| 4 | Pecherskyi district | Pecherskyi | 52940 | 6556 |
| 5 | Podilskyi district | Podilskyi | 28764 | 5307 |
| 6 | Dniprovskyi district | Dniprovskyi | 82180 | 4950 |
| 7 | Shevchenkivskyi district | Shevchenkivskyi | 21600 | 8786 |
| 8 | Solomianskyi district | Solomianskyi | 15343 | 7195 |
| 9 | Sviatoshynskyi district | Sviatoshynskyi | 32200 | 3062 |

Then I used **python folium** to visualize boroughs of Kyiv to superimpose the rest of data in further steps.

I utilized the Foursquare API to explore the boroughs and segment them. I set by default limit as **100 venues** and the radius **1000 meter** for each borough from their given latitude and longitude informations. Here is a head of the list Venues name, category, latitude and longitude informations from Forsquare API.

```
[107]: #Let's check the size of the resulting dataframe
       print(kyiv_venues.shape)
       kyiv_venues.head()

       (869, 7)
```

[107]:

| | Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|---|---|---|---|---|---|---|---|
| 0 | Holosiivskyi | 50.402778 | 30.515278 | Biblecoffee | 50.403717 | 30.514421 | Coffee Shop |
| 1 | Holosiivskyi | 50.402778 | 30.515278 | Закарпатський & Ko | 50.402728 | 30.515700 | West-Ukrainian Restaurant |
| 2 | Holosiivskyi | 50.402778 | 30.515278 | I Love Sport | 50.402141 | 30.517561 | Gym / Fitness Center |
| 3 | Holosiivskyi | 50.402778 | 30.515278 | OKwine | 50.400648 | 30.520036 | Wine Shop |
| 4 | Holosiivskyi | 50.402778 | 30.515278 | Home Cafe | 50.400455 | 30.520258 | Café |

Summary there were **869** venues returned by Foursquare. Here is a head of data frame of boroughs and venues.

Than I noticed that just 4 of the Boroughs have reached the **100** limit of venues – Darnytskyi, Dniprovskyi, Obolonskyi, Podilskyi in particular. Svyatoshynskyi has less than 50 venues.

The result doesn't mean that inquiry run all the possible results in boroughs. Actually, it depends on given Latitude and Longitude informations and here we just run single Latitude and Longitude pair for each borough.

In summary of this graph **201** unique categories were returned by Foursquare, then I created a table which shows list of top 10 venue category for each borough in below table.

| | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Darnytskyi | Coffee Shop | Gym / Fitness Center | Gym | Boutique | Italian Restaurant | Pharmacy | Hookah Bar | Middle Eastern Restaurant | Caucasian Restaurant | Pizza Place |
| 1 | Desnianskyi | Coffee Shop | Clothing Store | Park | Cosmetics Shop | Pizza Place | Supermarket | Sushi Restaurant | Movie Theater | Shopping Mall | Sculpture Garden |
| 2 | Dniprovskyi | Coffee Shop | Dance Studio | Restaurant | Café | Salon / Barbershop | Gym / Fitness Center | Caucasian Restaurant | Vegetarian / Vegan Restaurant | Dessert Shop | Arcade |
| 3 | Holosiivskyi | Coffee Shop | Café | Salon / Barbershop | Dance Studio | Gym | Pharmacy | Bus Stop | Beer Store | Gym / Fitness Center | Playground |
| 4 | Obolonskyi | Coffee Shop | Health & Beauty Service | Gym | Gym / Fitness Center | Bakery | Clothing Store | Pizza Place | Café | Supermarket | Dance Studio |
| 5 | Pecherskyi | Coffee Shop | Park | Café | Bakery | Spa | Gym | Caucasian Restaurant | Health & Beauty Service | Garden | Dance Studio |
| 6 | Podilskyi | Coffee Shop | Escape Room | Nightclub | Gym / Fitness Center | Art Gallery | Café | Hotel | Music Venue | Electronics Store | Seafood Restaurant |
| 7 | Shevchenkivskyi | Coffee Shop | Beach | Ukrainian Restaurant | Cosmetics Shop | Park | Soccer Field | Health & Beauty Service | Tea Room | Pet Store | Gym / Fitness Center |
| 8 | Solomianskyi | Coffee Shop | Park | Eastern European Restaurant | Restaurant | Café | Pet Store | Pizza Place | Italian Restaurant | Furniture / Home Store | Gym |
| 9 | Sviatoshynskyi | Coffee Shop | Park | Gym | Pizza Place | Convenience Store | Cosmetics Shop | Bus Stop | Café | Restaurant | Plaza |

We have some common venue categories in boroughs. In this reason I used unsupervised learning **K-means algorithm** to cluster the boroughs. K-Means algorithm is one of the most common cluster method of unsupervised learning.

I run K-Means to cluster the boroughs into 3 and 4 numbers, therefore the best results were received with 4 clusters.

Here is my resulting data frame with cluster labels for each borough.

| | Distr | lat | lon | Cluster Labels | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9... C... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Holosiivskyi | 50.402778 | 30.515278 | 0 | Coffee Shop | Café | Salon / Barbershop | Dance Studio | Gym | Pharmacy | Bus Stop | Beer Store | |
| 1 | Darnytskyi | 50.406111 | 30.626667 | 0 | Coffee Shop | Gym / Fitness Center | Gym | Boutique | Italian Restaurant | Pharmacy | Hookah Bar | Middle Eastern Restaurant | C... Re... |
| 2 | Desnianskyi | 50.510000 | 30.604167 | 1 | Coffee Shop | Clothing Store | Park | Cosmetics Shop | Pizza Place | Supermarket | Sushi Restaurant | Movie Theater | S... |
| 3 | Obolonskyi | 50.505528 | 30.499278 | 0 | Coffee Shop | Health & Beauty Service | Gym | Gym / Fitness Center | Bakery | Clothing Store | Pizza Place | Café | Supe... |
| 4 | Pecherskyi | 50.420556 | 30.549444 | 0 | Coffee Shop | Park | Café | Bakery | Spa | Gym | Caucasian Restaurant | Health & Beauty Service | |
| 5 | Podilskyi | 50.473889 | 30.501944 | 2 | Coffee Shop | Escape Room | Nightclub | Gym / Fitness Center | Art Gallery | Café | Hotel | Music Venue | Ele... |
| 6 | Dniprovskyi | 50.450000 | 30.487333 | 0 | Coffee Shop | Dance Studio | Restaurant | Café | Salon / Barbershop | Gym / Fitness Center | Caucasian Restaurant | Vegetarian / Vegan Restaurant | |

After having analyzed the data frame, we can label each cluster based on first 10 most common venues as follow:

- Cluster 0 : "Socializing and leisure"  with coffee shops and restaurants as a dominating venues
- Cluster 1 : "Residential area" within shops and supermarkets as a dominating venues
- Cluster 2 : "Culture and entertainment area" within high concentration of clubs and music venues

We can also examine the level of average commercial property sales prices in different boroughs.

As it looks at choropleth map, we can define the ranges as below:

- Less than 37399 UAH per sq. m. – Low Level
- 37399 – 48762 UAH per  sq. m. – Lower Medium Level
- 48762 – 60124 UAH per sq. m. – Medium Level
- 60124 – 71486 UAH per sq. m.  Upper Medium Level
- more than 71486 UAH per sq. m. – High Level

### 3. Results

As a result of above research we received a clustered map of Kyiv boroughs with choropleth layer added visualizing the average commercial property sale prices. The map consists of follow information for each borough:

- Borough name
- Cluster name,
- Housing Sales Price (HSP) Levels
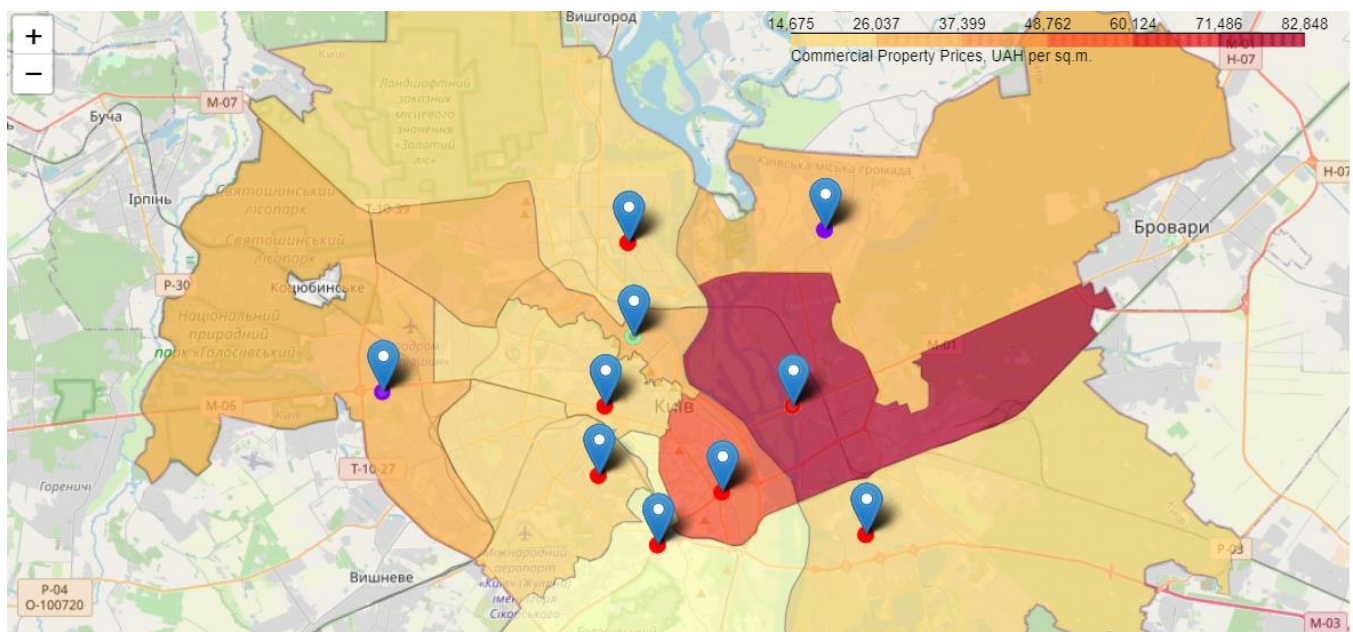
## 4. Discussion

As it was mentioned before, Kyiv is a medium sized European city with an average high population density that may vary for each Borough and therefore very different approaches can be tried in clustering and classification studies.

Due to a limited number of venues returned by Foursquare API the resulting data frame of venues didn`t depict all the possible variability of the Borough as I supposed. For more detailed and accurate guidance, the data frame would be expanded and the extra details of the borough's social and culture environment can be drilled as well.

I also performed data analysis through this information by adding the coordinates of districts and home sales price averages as static data on GitHub. In future studies, these data can also be accessed dynamically from specific platforms or packages.

I concluded my research by visualizing the data and clustering information on the Kyiv map. In future studies, other types of user interfaces would be carried out to the vendors.

## 5. Conclusion

While working on the project I felt an unexpected lack of classified information in the open data sources on Kyiv city environment, as well as very poor level of customized online tools to analyze it.

The results of my project could be just a small part of further research to be done and settled as an open source platform performing analysis and providing structured information for interested vendors.

For this reason, vendors would be rather interested in having access to the platforms where such information is provided, and achieve better outcomes through it.

As well urban research organizations are another interested body to perform and utilize such a platform in their activities.