Asian restaurant location recommendation in the city of Nur-Sultan

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Introduction

Nur-Sultan is the capital city of Kazakhstan and one of the most developed cities of the country that attracts lots of tourists and businesses. Currently, the number of restaurants offering variety of cuisines are increasing significantly throughout the city. In this project the recommendation on where to open a restaurant will be given taking as an example a case of Asian cuisine restaurant in Nur-Sultan. However, the process can be repeated for any other type of restaurant in any city.

Business problem

Some of the restaurants are being closed due to a bad choice of location or the lack of initial research. The location of a restaurant has a significant impact on the revenue, thus analysis of the currently open restaurants in terms of the frequency, locations, distance to other restaurants etc. is important. In this project, the number of possible locations within the city will be offered in terms of vicinity to other restaurants.

Data

In this project the locational data of different venues and candidate locations around the Nur-Sultan city will be used. First, the latitude and longitude range of Nur-Sultan city was identified which ranges from 51.07 to 51.22 and 71.37 to 71.54, respectively. Then, evenly spaced locations around the city center were generated in the identified range. The final rectangular grid that covers most of the city is shown in Fig. 1.

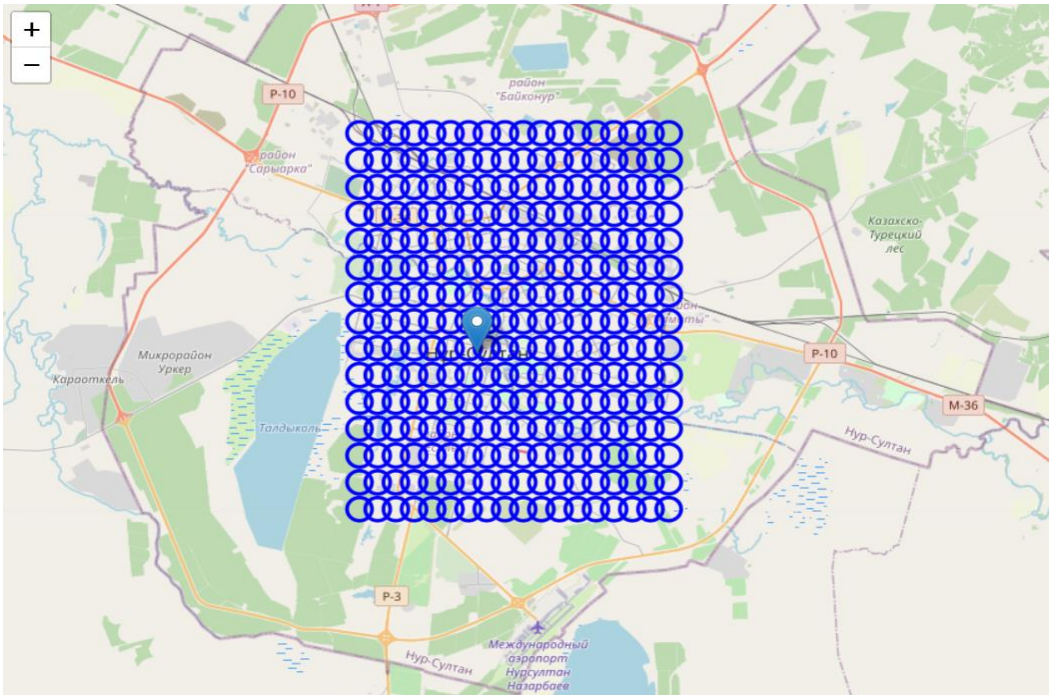


Figure 1. Rectangular grid of evenly spaced 270 locations around the city

Using the Foursquare API all venues around these 270 locations were identified. The data such as restaurant name, longitude, latitude and category were obtained from the Foursquare API and used for analysis. This data will be cleaned and each candidate location will be analyzed based on the following properties:

- The number of other restaurants within radius of 400 meters
- The number of Asian restaurants within radius of 400 meters

Data cleaning

Since the locational coordinates overlap, there were some of duplicate venues, which were dropped. After dropping duplicate venues, we have 865 unique venues, but it includes all types of venues such as cinema, supermarkets, concert hall etc. However, we are interested only in restaurants, so only restaurants were sorted out from the dataframe and other nonrelated venue categories were dropped. Finally, our dataframe contains 442 restaurants and depicted in Fig. 2.

	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	51.07	71.386	Nomads Restaurant	51.067540	71.385736	Restaurant
1	51.07	71.406	Underground Sport Bar	51.064540	71.409202	New American Restaurant
2	51.08	71.386	Cafeteria NU	51.078754	71.393878	Café
3	51.08	71.406	Столовая Expo 2017 Astana	51.077414	71.413949	Cafeteria
4	51.09	71.396	Starbucks	51.089568	71.404154	Coffee Shop
...	...	...	...	...	...	...
437	51.20	71.406	перрон	51.194940	71.409684	Bistro
438	51.20	71.406	Замира	51.204061	71.412133	Bistro
439	51.20	71.406	Coffee room/Astana Train Station	51.194523	71.408830	Coffee Shop
440	51.20	71.466	Смак	51.201302	71.469566	Bistro
441	51.21	71.376	hardees	51.204940	71.378679	Bistro

442 rows × 6 columns

Figure 2. The final dataframe containing information about all restaurants

Methodology

After all the data about the venues were gathered from Foursquare API and cleaned, they were visualized on a map using Folium library. Our main aim for this project was to recommend locations in the city that are popular among tourists but does not have Asian restaurants nearby. So, places that have more than two restaurants and do not have Asian restaurants at 400 m radius were identified.

In order to find such places, we separated Asian and non-Asian restaurants. All categories that are related to Asian were separated, these categories are: Asian restaurants, Chinese restaurants, Japanese restaurants and Sushi restaurants. The location of a Sushi or Japanese restaurant near to our Asian restaurant might create a competition and results in a reduced profit, thus they were included to Asian restaurants category. In addition, for exploring their density and spread around the city frequency plots were generated, the percentage of Asian restaurants were calculated and heatmaps were visualized.

By analyzing each area and density of restaurants, several places that satisfy our two conditions (>2 restaurants and no Asian restaurants at 400 m) were identified. Using k-mean clustering those locations will be grouped into k general areas that our stakeholders might consider for opening there Asian restaurant.

Results

First, the frequency of each category was visualized using a bar chart in order to see how popular Asian restaurants are in the city. The resultant plot is shown in Fig. 3. All Asian and non-Asian restaurants were separated, and general statistical information was calculated. In general, 442 food venues were returned by the Foursquare API in the defined area, 52 (11.76%) of which are Asian restaurants.

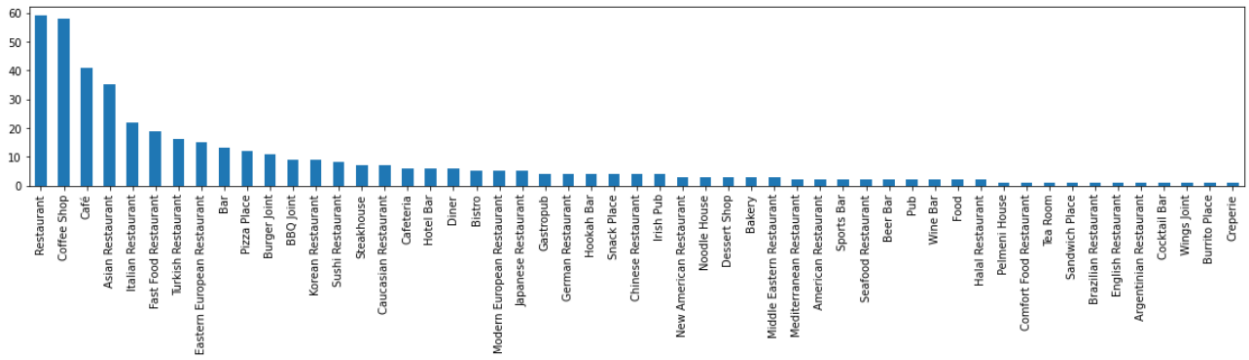


Figure 3. Frequency of each food venue categories

To observe the distribution of restaurants across the city, the restaurants were visualized on a Nur-Sultan map. First plot on Fig. 4 shows each restaurant on a map by indicating Asian restaurants as a blue circle and other restaurants as a red circle. Fig 5 (a) shows a heatmap of all restaurants, whereas Fig 5 (b) show a heatmap of only Asian restaurants.

For further identification of potential locations, for each 270 potential locations number of restaurants in the radius of 400 meters and distance to the closest Asian restaurant was calculated. Of those 270 locations 33 have more than two restaurants and 257 have no Asian restaurants at the radius of 400 m. 22 locations satisfy both conditions. Then by visually observing all of these locations they were clustered into 5 locations. This was done in order to suggest a general area that is suitable for restaurant location, since 22 locations are mostly clustered in several areas.

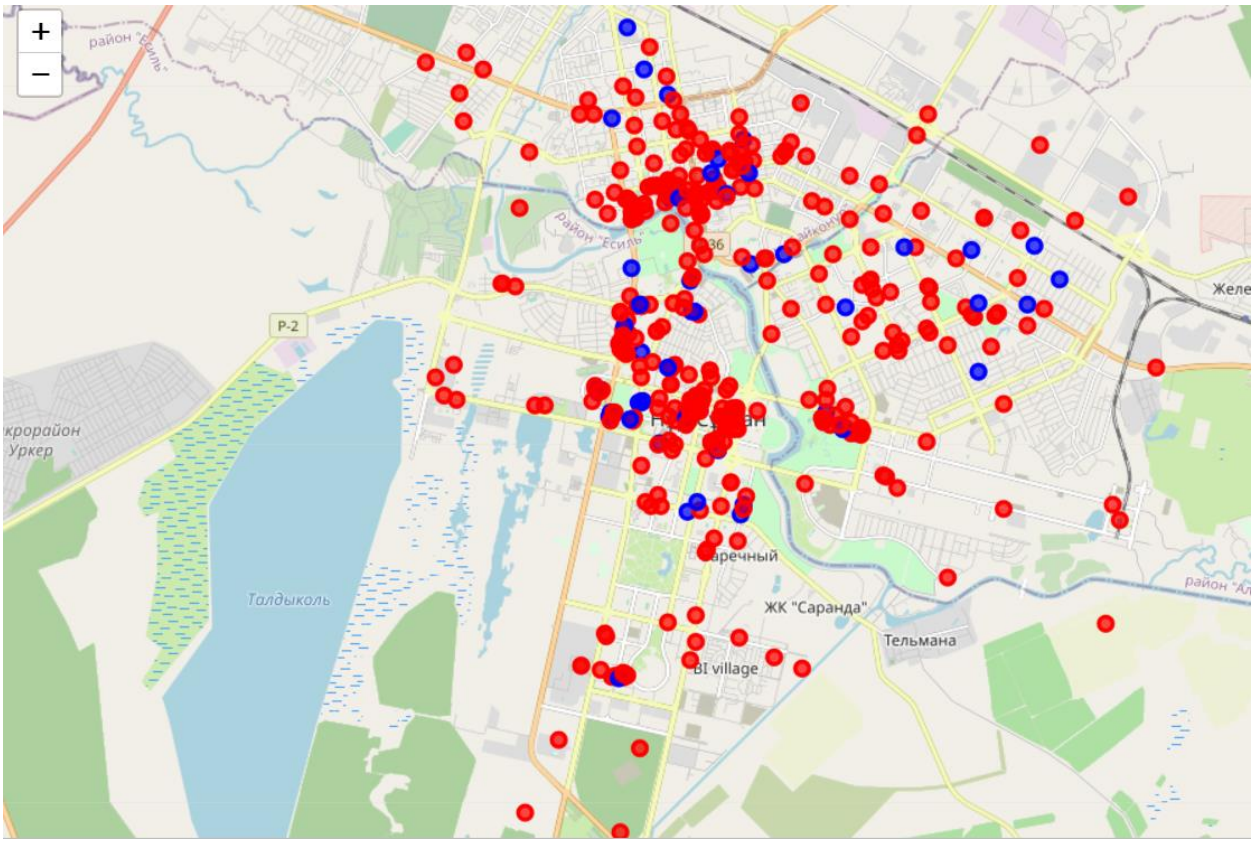
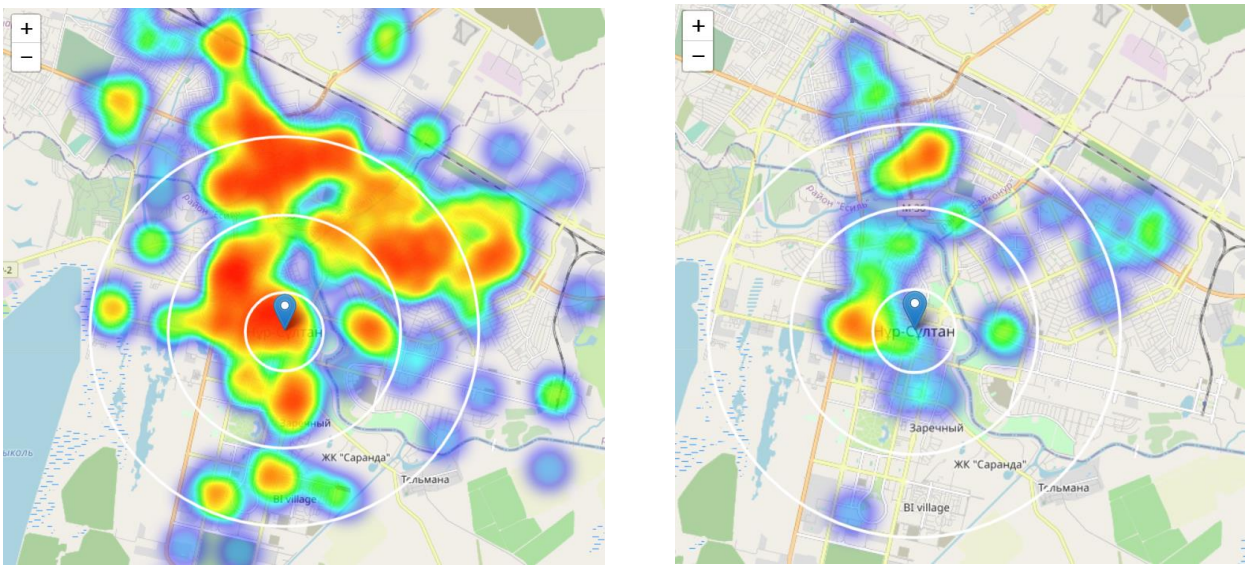


Figure 4. Map of Nur-Sultan showing Asian (blue) and non-Asian (red) restaurants



(a) (b)

Figure 5. Heatmap of all (a) and Asian (b) restaurants

Discussion

From Fig 3. it can be observed that Asian is the most popular cuisine in the city and widely spread around the city and present in almost all regions of the city. Also, from heatmap of the restaurants (Fig. 5 (a)), restaurants are mostly located near Baiterek monument, near Presidential park, EXPO and Naberezhnaya street. Asian restaurants are also present in all these locations, but by observing closely, pockets with the no Asian restaurants nearby can be found.

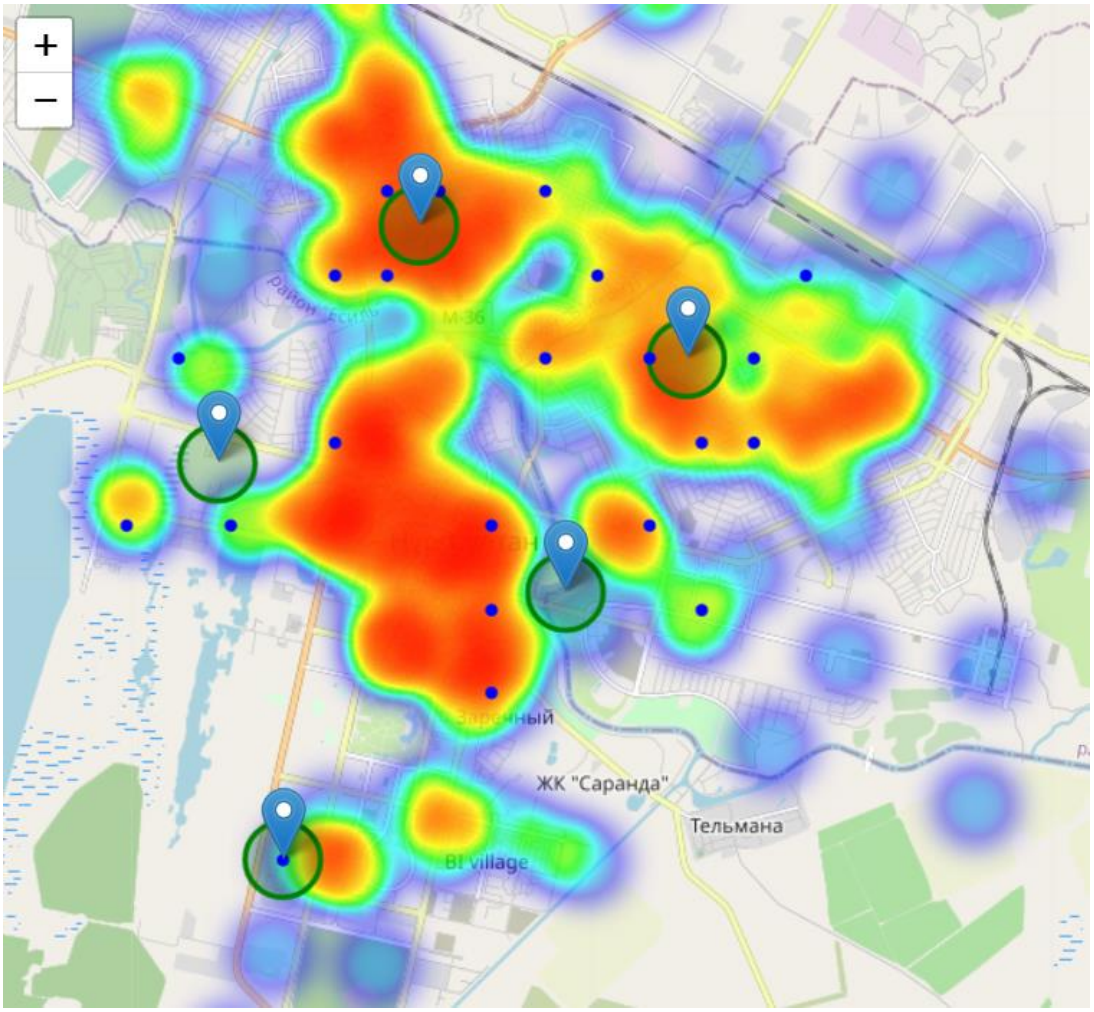


Figure 6. Suitable locations (shown as blue dots) and 5 clusters shown on top of a heatmap of the restaurants

By observing the recommended locations and cluster centers, all cluster centers are located in places that have high restaurant density and are popular among tourists. For instance, location near

Nazarbayev University is close to offices and shopping mall. Another one near Presidential Park has good food traffic and popular among tourists. Other three locations along K. Muhammedzhanova street, along Respublika prospect and at K. Satbayeva street have many living blocks nearby. As a resident of Nur-Sultan city, I can assure that all these locations are good for potential Asian restaurant location. However, the purpose of this analysis was to suggest possible locations that do not have Asian restaurants nearby and have other restaurants near. These locations should only be considered only as a starting point for more detailed analysis which could eventually result in location which has not only less competition, but also other factors taken into account.

Conclusion

In this project, places that has good food traffic, but do not have Asian restaurants at a distance of 400 meters were suggested for the stakeholders for narrowing down the search of optimal locations for an Asian restaurant. By generating the grid of possible locations, list of all venues nearby was obtained. By cleaning the data, analyzing and visualizing it, potential locations that satisfy our conditions on the number of non-Asian and Asian restaurants were identified. Then these locations were clustered into major areas to be used by a stakeholder as a starting point for further analysis. The stakeholders might further analyze these areas in terms of closeness to other venues (parks, trading houses), accessibility, socio-economic situations of the area and more.