

The Battle of Amsterdam Neighborhoods

I. INTRODUCTION

Amsterdam, as one of the most renowned international cities, is a vast melting pot of different nationalities, ethnicities and cultures. Diversity is one of the city's main characteristics and so is with the restaurant industry. Almost every street in Amsterdam is filled with varieties of restaurants, cafeteria or fast food that are influenced by different cultures. Cuisines such as French, Italian and Chinese can be easily found in Amsterdam.

With the great number and variety of restaurants, opening a new establishment and making it stand up against the others could be challenging. Factors such as location, price, cuisine types, number of restaurants nearby should be well considered.

Our client, who is good at various but preferably Japanese cuisines, would like to open a high-end restaurant in one of the boroughs of Amsterdam.

The aim of this report is to address the questions below, so as to help our client make decisions on the spot that opens his restaurant. This report may also be interesting for other people that plan to open a restaurant in Amsterdam.

- Which borough has the least restaurants?
- Which borough has the maximum population-restaurant ratio?
- Which borough is rated highest on general?
- Which borough has mostly expensive restaurants?
- What is the similarity of boroughs regarding cuisine types?
- Which is the best borough, if our client prefers to open a high-end Japanese restaurant?

II. DATA

The data of the report consists of two parts: 1.) Amsterdam borough information scraped from the Wikipedia page: https://en.wikipedia.org/wiki/Boroughs_of_Amsterdam; and 2.) Amsterdam venue information provided by Foursquare API.

1.) Amsterdam borough information

The Amsterdam borough data in the aforementioned Wikipedia page include 4 parts: Borough name, Area, Population and Population Density. The data are load into a pandas dataframe and are processed subsequently, e.g., trimming contents inside brackets, removing 'km²' and casting strings into numeric data types. Latitude, Longitude of each borough are obtained using geopy package and are concatenated to the borough dataframe (see Fig. 1). Note that the borough Westpoort is mainly a harbour and has very few permanent inhabitants. To this end, Westpoort is excluded from the analyses of this report.

	Borough	Area	Population	PopulationDensity	Latitude	Longitude
0	Centrum	8.04	86422	13748	52.373730	4.895691
1	Noord	49.01	94766	2269	52.401739	4.915352
2	Nieuw-West	32.38	151677	4478	52.363777	4.813812
3	Oost	30.56	135767	7635	52.356608	4.930577
4	West	9.89	143842	15252	52.376672	4.863724
5	Westpoort	10.00	192	10	52.411890	4.800289
6	Zuid	17.41	144432	9349	52.344470	4.878664
7	Zuidoost	22.08	87854	4391	52.310514	4.960695

Fig. 1. Web scraped Amsterdam borough dataframe, concatenated with the location latitude and longitude information.

2.) Amsterdam venue information provided by Foursquare API

Foursquare is a local search and recommender system. Its venue database contains more than 105 million places, with key descriptors such as venue names, categories, ratings, and reviews.

The venues within 1 km radius of each borough center are retrieved using Foursquare API, and are filtered based on venue category. Only venues with category keyword ‘Restaurant’ are preserved: 145 restaurants are remaining after data filtering. In addition, a couple of the restaurants are relabelled based on their cuisine types, e.g., ‘Sushi Restaurant’ and ‘Ramen Restaurant’ are re-labelled with ‘Japanese Restaurant’.

To address the questions aforementioned in the introduction section, venue ratings, price levels are retrieved as well, which are calculated by Foursquare based on feedback of millions of users, quick tips and verified check-ins. (see Fig. 2).

	Borough	Borough_Latitude	Borough_Longitude	Venue_Name	Venue_Latitude	Venue_Longitude	Venue_Category	Rating	Price	Price_Tier
0	Centrum	52.373730	4.895691	La Zoccola del Pacioccone	52.375297	4.893965	Italian Restaurant	8.8	Moderate	2.0
1	Centrum	52.373730	4.895691	Kaagman & Kortekaas	52.374878	4.892455	French Restaurant	9.0	Expensive	3.0
2	Centrum	52.373730	4.895691	Wok to Walk	52.372014	4.895579	Asian Restaurant	8.6	Moderate	2.0
3	Centrum	52.373730	4.895691	Oriental City	52.371912	4.895994	Chinese Restaurant	8.4	Moderate	2.0
4	Centrum	52.373730	4.895691	The Lobby	52.371159	4.893661	Restaurant	9.1	Moderate	2.0
5	Centrum	52.373730	4.895691	Ashoka Restaurant (Amsterdam Centrum)	52.376086	4.892356	Indian Restaurant	9.1	Moderate	2.0
6	Centrum	52.373730	4.895691	FuLu Mandarijn Amsterdam	52.371684	4.892720	Chinese Restaurant	8.7	Moderate	2.0
7	Centrum	52.373730	4.895691	Maenaam Thai	52.375184	4.891260	Thai Restaurant	8.7	Moderate	2.0

Fig. 2. Category, rating and price details of restaurants in Amsterdam boroughs

III. METHODOLOGY

A. Exploratory data analysis

In each borough¹, 4 factors are explored: 1.) restaurant count; 2.) population-restaurant ratio; 3.) restaurant rating; and 4.) restaurant price. In addition, data exploration for Japanese restaurants are performed specifically, due to its importance to our client.

1.) Restaurant count

The number of restaurants is counted per borough and is sorted in descending order (see Fig. 3). Oost and West have the highest number of restaurants, while Nieuw-West and Noord have the least restaurants.

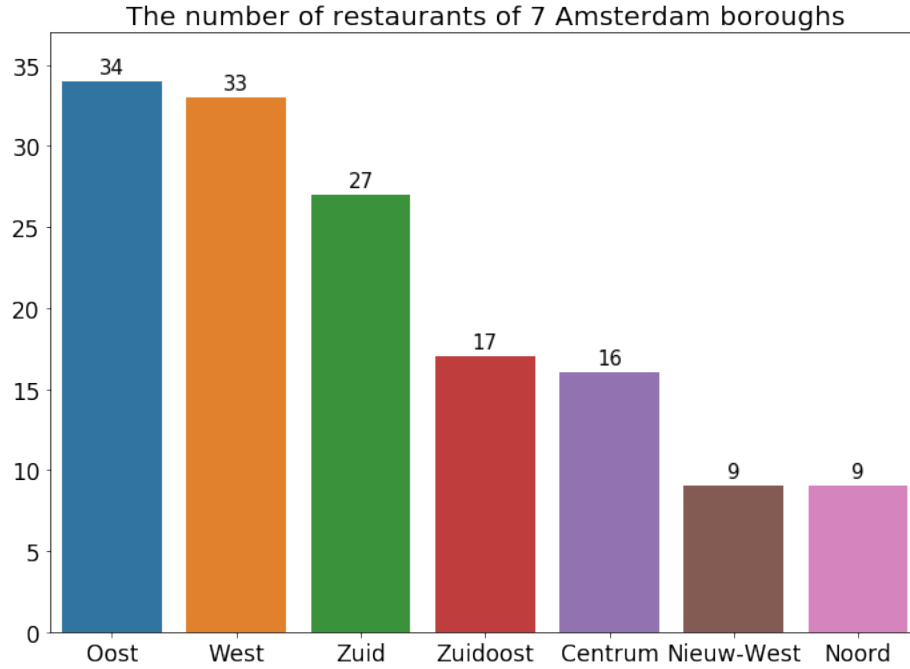


Fig. 3. The number of restaurants of 7 Amsterdam boroughs.

2.) Population-restaurant ratio

Population-restaurant ratio is calculated by the number of people divided by the number of restaurants within a certain region.

Given D_i the population density of the i_{th} borough, r the radius from the borough center, N_i the number of restaurants within radius r from the i_{th} borough center, the population-restaurant ratio of the i_{th} borough is calculated as:

$$R_i = \frac{D_i \pi r^2}{N_i}$$

Fig. 4 shows population-restaurant ratios 7 boroughs. Centrum has the maximum population-restaurant ratio, followed by Nieuw-West and West. Compared with the other boroughs, the population-restaurant ratio of Centrum is much higher, 1.7-fold of the second highest and 3.8-fold of the last borough.

¹ Within 1 km radius from the borough center.

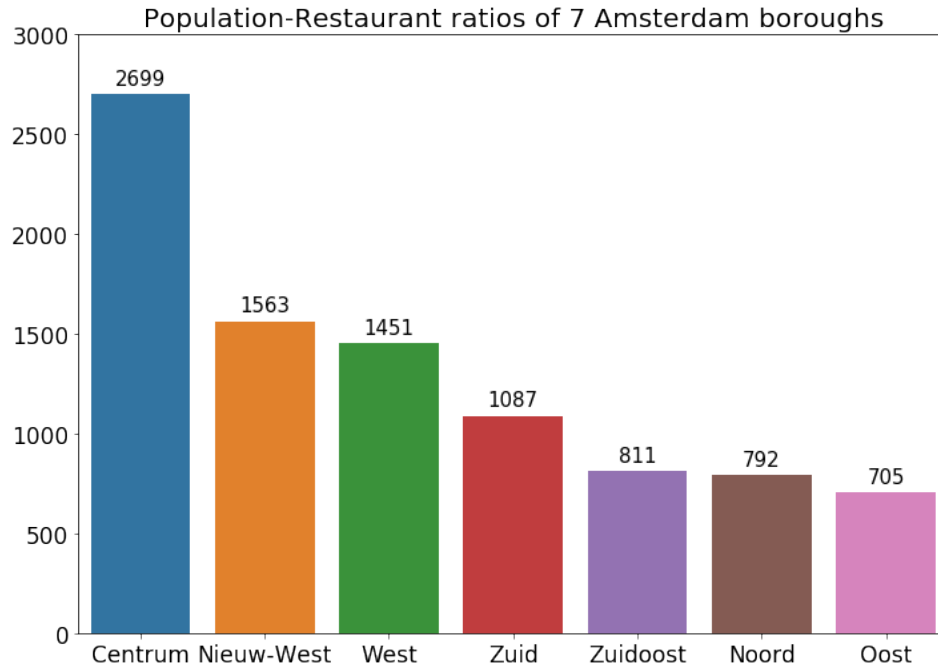


Fig. 4. The population-restaurant ratios of 7 Amsterdam boroughs.

3.) Restaurant rating

The venue ratings in Foursquare are from 0 to 10. Zero is the lowest rating and 10 is the highest rating. The boxplot graph is used to depict the median value as well as the distribution shape of restaurant ratings. Seen from Fig. 5, the 25th percentile and 75th percentile of Centrum are both higher than the rest of the boroughs. The same goes for the median rating, with Centrum rating score 8.8 on the top.

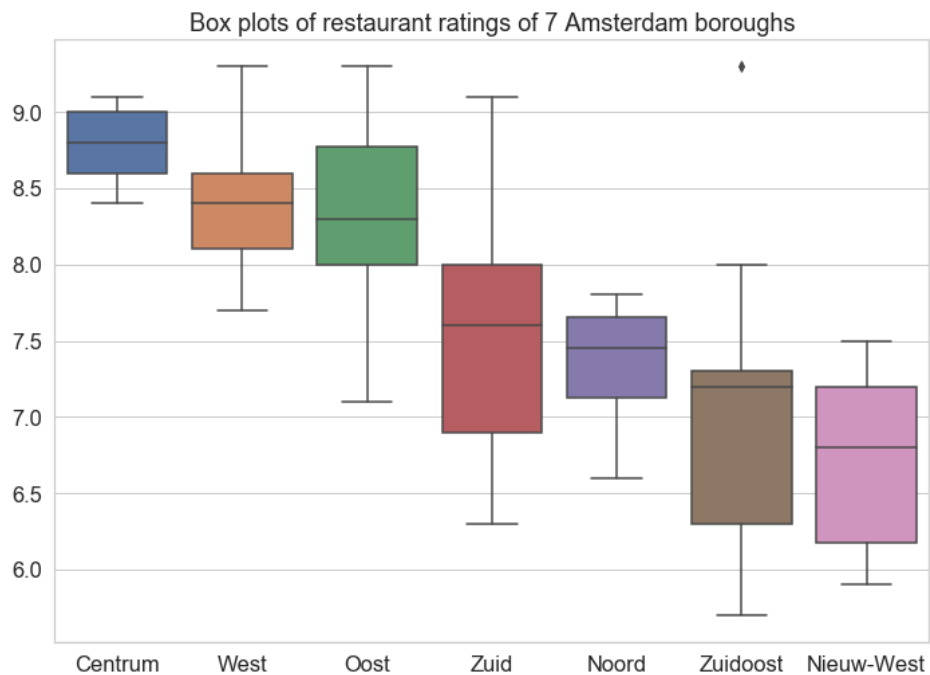


Fig. 5. Box plots of restaurant ratings 7 Amsterdam boroughs.

4.) Restaurant price

The restaurant price has 4 tiers. 1: cheap; 2: moderate; 3: expensive; 4: very expensive. Since high-end restaurants are the focus of our client, the percentage of expensive restaurants (with price tier 3 and 4) is calculated per borough (See Fig. 6). Centrum has the highest percentage of expensive restaurants, which is 31.25%.

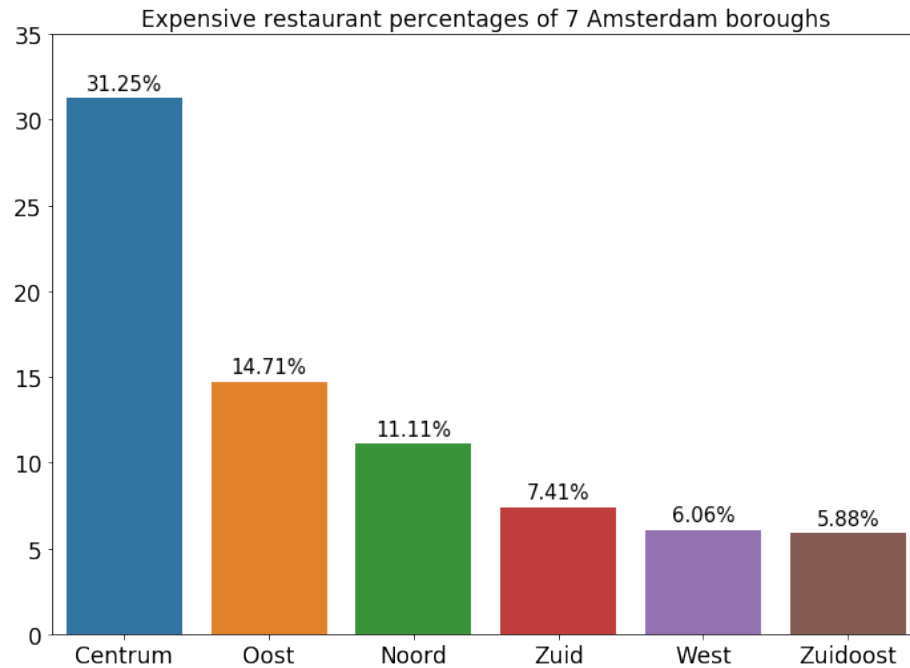


Fig. 6. Expensive restaurant percentages of 7 Amsterdam boroughs.

5.) Japanese restaurants

The number, the rating, as well as the price tier are explored for the Japanese restaurants of 7 boroughs. See Table 1, the Japanese restaurants are only available in Zuid and West, with a moderate price tier.

Table 1: Number, median rating and price tier of the Japanese restaurants in 7 boroughs.

	Count	Median rating	Median price tier
Zuid	6	8.35	2.0
West	2	7.67	2.0
Centrum	0	NA	NA
Oost	0	NA	NA
Noord	0	NA	NA
Zuidoost	0	NA	NA
Nieuw-West	0	NA	NA

B. Borough clustering based on cuisine similarity

Boroughs are clustered based on restaurant percentage of each cuisine type. Only the restaurants with explicit cuisine types are included for clustering exploration. In total, 124 restaurants are included, along with 39 unique cuisine types. Table 2 shows top 5 most common restaurants of each borough.

Table 2: Top 5 most common restaurants of 7 boroughs

	Top 1	Top 2	Top 3	Top 4	Top 5
Centrum	French (30.77%)	Thai (15.38%)	Chinese (15.38%)	Italian (7.69%)	Asian (7.69%)
Nieuw-West	Chinese (28.57%)	Asian (14.29%)	Turkish (14.29%)	Moroccan (14.29%)	Indian-Chinese (14.29%)
Noord	Turkish (33.33%)	Fast Food (33.33%)	Tai (16.67%)	French (16.67%)	American (16.67%)
Oost	Italian (16.13%)	French (12.90%)	Turkish (12.90%)	Vegetarian (9.68%)	Asian (9.68%)
West	Italian (20.00%)	French (6.67%)	Japanese (6.67%)	Indonesian (6.67%)	Greek (6.67%)
Zuid	Japanese (27.27%)	Italian (22.73%)	Asian (9.09%)	Thai (9.09%)	French (4.55%)
Zuidoost	Chinese (20.00%)	Italian (13.33%)	Fast Food (13.33%)	Doner (6.67%)	Scandinavian (6.67%)

K-means is used to cluster the 7 boroughs based on restaurant percentage of each cuisine type. Elbow method is used to determine the optimal 'K'. As seen in Fig. 7, the 'elbow' location is a bit ambiguous. Here k = 5 is chosen as the optimal k for k-means clustering.

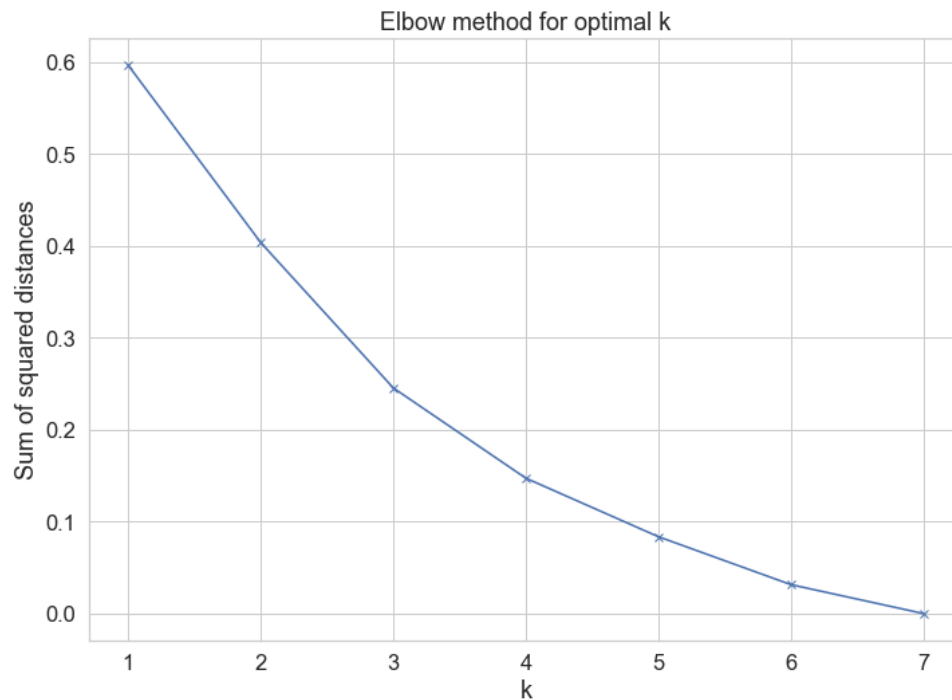


Fig. 7. Elbow method for optimal k.

Table 3 shows cluster labels of 7 boroughs based on k-means clustering. The borough clusters are in line with the restaurant percentage of each cuisine type of boroughs in Table 2.

Table 3: Cluster labels of 7 boroughs based on k-means clustering.

	Cluster label
Oost	1
West	1
Noord	2
Nieuw-West	3
Zuidoost	3
Centrum	4
Zuid	5

Oost and West are in the 1st cluster. Italian is the top 1 cuisine, with restaurant proportions 16.13% and 20.00%, respectively. Noord is in the 2nd cluster. Turkish cuisine and fast food are dominant (in total 66.66%). Zuidoost and Nieuw-West are in the 3rd cluster. Chinese is the most popular cuisine (20.00% and 20.57%, respectively). Centrum is in the 4th cluster. French cuisine takes a high percentage among all the cuisine types (30.77%). Zuid is in the 5th cluster. Japanese and Italian are the top 2 cuisines, around 50% of the total cuisines.

IV. Results

The results of the exploratory data analysis and data clustering are summarized by answering the questions raised in the introduction.

- **Which borough has the least restaurants?**
Nieuw-West and Noord have the least restaurants. Both of these two boroughs have only 9 restaurants.
- **Which borough has the maximum population-restaurant ratio?**
Centrum has the maximum population-restaurant ratio, is 1.7-fold of the second place (Nieuw-West) and is much higher compared with the other boroughs.
- **Which borough is rated highest?**
Centrum has the highest median rating among boroughs (8.8 out of 10), and has a very small rating interquartile range. This suggests that Centrum is the borough with a great proportion of high-rated restaurants, and is rated higher than the other boroughs.
- **Which borough has mostly expensive restaurants?**
Centrum has mostly expensive restaurants, with 31.25% restaurants with the price tiers 3 and 4.
- **What is the similarity of boroughs regarding cuisine types?**
Base on popular cuisine types, Oost and West are similar, with Italian the top 1 cuisine. Zuidoost and Nieuw-West are comparable, with Chinese the most popular cuisine. Turkish cuisine and fast food are dominant in Noord. French cuisine has a high percentage in Centrum, while Japanese is mainly found in Zuid.
- **Which is the best borough, if our client prefers to open a high-end Japanese restaurant?**
Our recommendation would be Centrum. Firstly, Centrum has the maximum population-

restaurant ratio. Compared with the absolute number of restaurants, population-restaurant ratio properly reflects the restaurant shortage in one region. Secondly, Centrum has mostly high-rated and high-price-tier restaurants which suggests that Centrum is the high-end restaurant region. French is the main cuisine type of Centrum. The number of Japanese restaurants in Centrum, however, is zero. It is an opportunity for our client to open a high-end Japanese restaurant to fill this gap.

V. Discussion

This report is to help our client make decisions on the spot to open his restaurant in Amsterdam.

Using exploratory data analysis, the restaurant features in 7 boroughs of Amsterdam are explored. We observed that Centrum is highly distinctive with the other boroughs. It has the highest population-restaurant ratio, highest restaurant rating and proportion of high-end restaurants. Based on the fact that Centrum seats the most high-end restaurants but is lack of Japanese cuisine, we recommend our client open a high-end Japanese restaurant in Centrum.

Our data exploration still has limitations. For instance, due to lack of land price information, the cost factor was not taken into account in our analysis. The ideal location may be costly and beyond the budget of our client. The cost factor needs to be investigated in future when the data are available.

VI. Conclusion

In this report, we explored restaurants in 7 boroughs of Amsterdam. Restaurant count, population-restaurant ratio, restaurant rating and price tier are analysed per borough. Based on our analysis, we recommend our client that Centrum may consider the suitable place to open a high-end Japanese restaurant. The report may also be helpful to the other people that plan to open a restaurant in Amsterdam.