

Tastes of Osaka

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1. Introduction

1.1 Background

Osaka is located in the southwest of Honshu Island, roughly in the center of Japan. It is the capital of Osaka Prefecture and the center of industry, commerce, and transportation in the Kansai region [1]. Osaka is listed as one of the most representative metropolises in Japan, and it is also an internationally renowned city in the world (Fig. 1).



Figure 1. Osaka landscape during the night (photo was taken by the author in Osaka, 2018).

Osaka has existed as a thriving and prosperous town where people gather and communicate as early as 1400 years ago. Osaka's food culture also makes this ancient city a place in the gastronomic world. Osaka is known as the "national kitchen" in Japan, there are not only Japanese classic dishes but also cuisines from all over the world, which has fascinated countless tourists visiting Osaka (Fig. 2).



Figure 2. Dining in Osaka (photos were taken by the author in Osaka, 2018).

1.2 Business problem and target audience

When people come to a foreign city for the first time, looking to get a real sense of a destination through its cuisine and dining culture, often the sheer volume of choice can make determining what to eat an exhausting experience.

The goal of this project is to provide a dining and restaurant guide for people who plans to travel to Osaka. In addition, this project may offer useful information for people who wants to invest or open a restaurant in Osaka.

2. Data section

2.1 Data features

To solve the problems in this project, the following data will be needed:

(1) [The information about wards in Osaka](#). A ward is a subdivision of the cities of Japan. Osaka is a gigantic city composed of 24 wards. For example, the famous ward in Osaka, Tennōji, has the first Buddhist temple, Shitennō-Ji Temple, in Japan. In addition to the name of the wards in Osaka, we will also need the location and geographical coordinates of those wards.

(2) [The venue and restaurant information](#). With the geographical coordinates of the wards, we will be able to acquire the information of venues and restaurants in those wards, including the latitude, longitude, name, and category of the venues.

2.2 Data sources

The ward information can be found easily on [Wikipedia](#), which is a multilingual encyclopedia operated by the Wikimedia Foundation. It is the largest and most popular online reference work and is ranked among the top ten most popular websites in the world [2].

The venue and restaurant information can be obtained from [Foursquare Places API](#). Foursquare is a location-based online social network. Foursquare Places API offers real-time access to Foursquare's global database for developers to explore the attributes of commercial venues [3].

3. Methodology section

3.1 Data collection for ward information

The postal codes of Osaka wards were obtained from the Wikipedia page “ward of Japan”[2] by using

BeautifulSoup library [4] and web-scraping. The geographical coordinates of wards in Osaka were obtained by using geopy [5] (Fig. 3). To increase the accuracy for coordinates results, a new column with '-ku, Osaka' added to the ward names was created and used for coordinates acquiring and dropped afterward.

	Wards	Kanji	Area	Latitude	Longitude
0	Abeno	阿倍野区	5.98	34.627501	135.514095
1	Asahi	旭区	6.32	34.726483	135.546952
2	Chūō	中央区	8.87	34.679846	135.510316
3	Fukushima	福島区	4.67	34.692104	135.474812
4	Higashinari	東成区	4.54	34.672912	135.550567

Figure 3. The Wards of Osaka (first 5 rows as an example).

3.2 Visualization of geospatial data

The visualization of geospatial data was achieved by using Folium [6]. The map of Osaka with wards marked with white circles is shown in Fig. 4

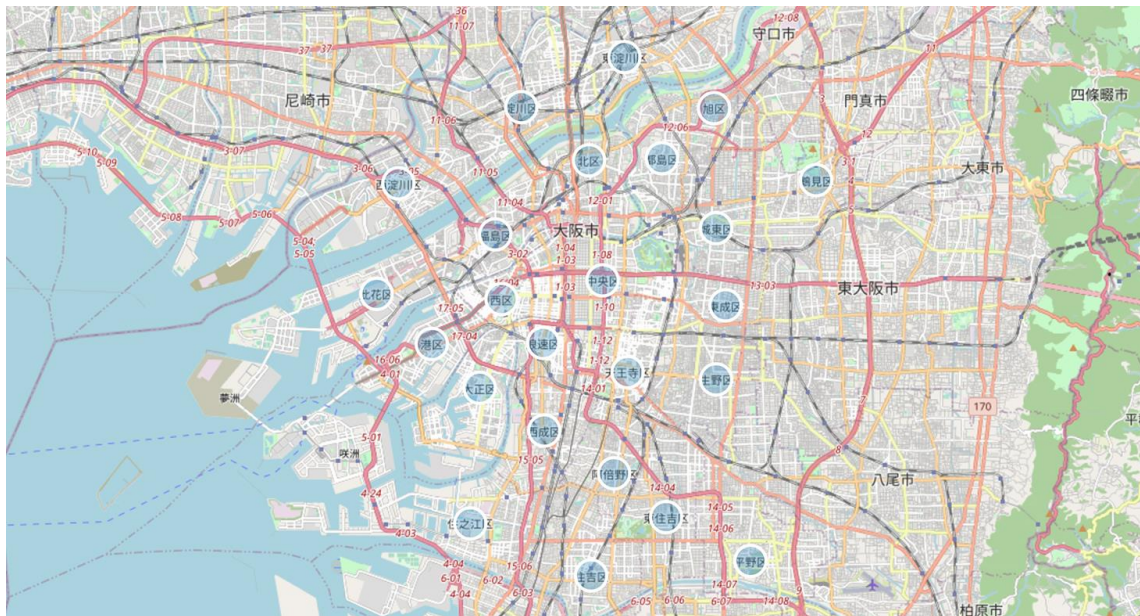


Figure 4. The wards of Osaka on the map.

3.3 Foursquare data

The venue data from Osaka was acquired from the Foursquare API. The radius was set as 1.7 km because some of the areas are too close (e.g. Minato and Konohana). The acquired data consisted of 2266 venues, and 624 restaurants were found among the venues.

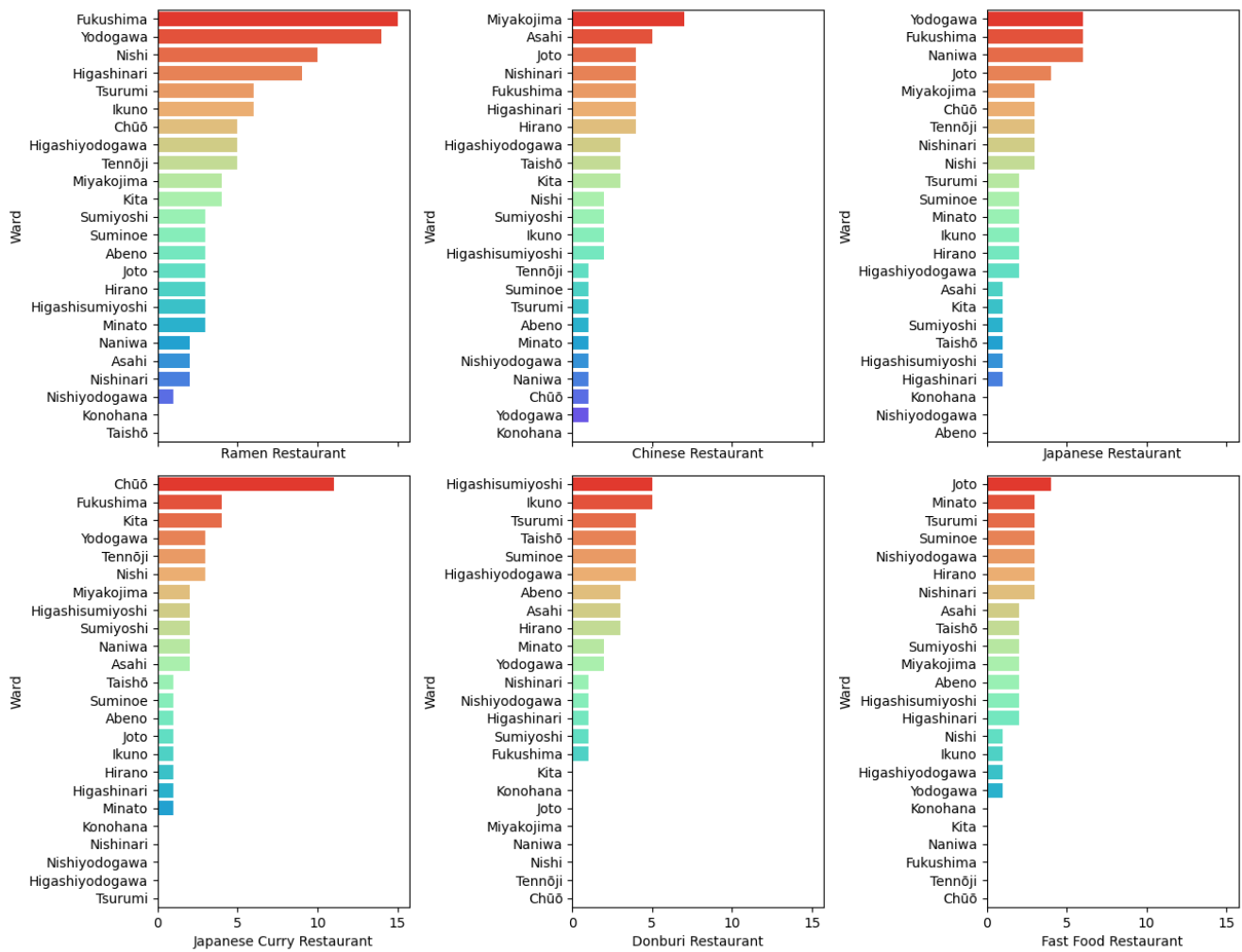
3.4 K-means clustering and silhouette analysis

K-means clustering is one of the simplest and popular unsupervised machine learning algorithms. This algorithm allocates data points to the nearest cluster by identifying k number of centroids and keeping the centroids as small as possible. In this project, we will use the k-means clustering to cluster the wards in Osaka and to get a better sense of the local conditions and customs in different areas. The optimization of k for the k-means clustering was done by using the silhouette analysis, which is a method to study the separation distance between the resulting clusters and determines how well each object lies within its cluster [7].

4. Result section

4.1 Restaurants

The data shows that the most common restaurant category in Osaka is the Ramen Restaurant (111), which is almost twice as many as the second category Chinese Restaurant (58). Some other categories, such as Japanese Restaurant (58), Japanese Curry Restaurant (46), Donburi Restaurant (44), Fast Food Restaurant (40), Sushi Restaurant(39), and Udon Restaurant(30) are also very common. Two of the famous dishes in Osaka, Okonomiyaki and Kushikatsu, were found to have 16 and 11 restaurants according to the results, respectively. The six most common restaurant categories in each ward were shown in Fig. 5.



According to the search results, Fukushima and Chūō have the highest number of restaurants (49 and 42), while Nishiyodogawa and Konohana have the lowest number of restaurants (9 and 7) (Fig. 6).

4.2 Venue results

Some food/drink-related venues may not have the keyword ‘restaurant’, such as BBQ Joint and Sake Bar, therefore we will also analysis the common venues in each ward. The six most common venue categories in each ward were shown in Fig. 7. It can be seen that convenience stores are almost everywhere in Osaka; however, few convenience stores were found in Fukushima, Nishi, Chūō, Kita, Naniwa and Tennōji.

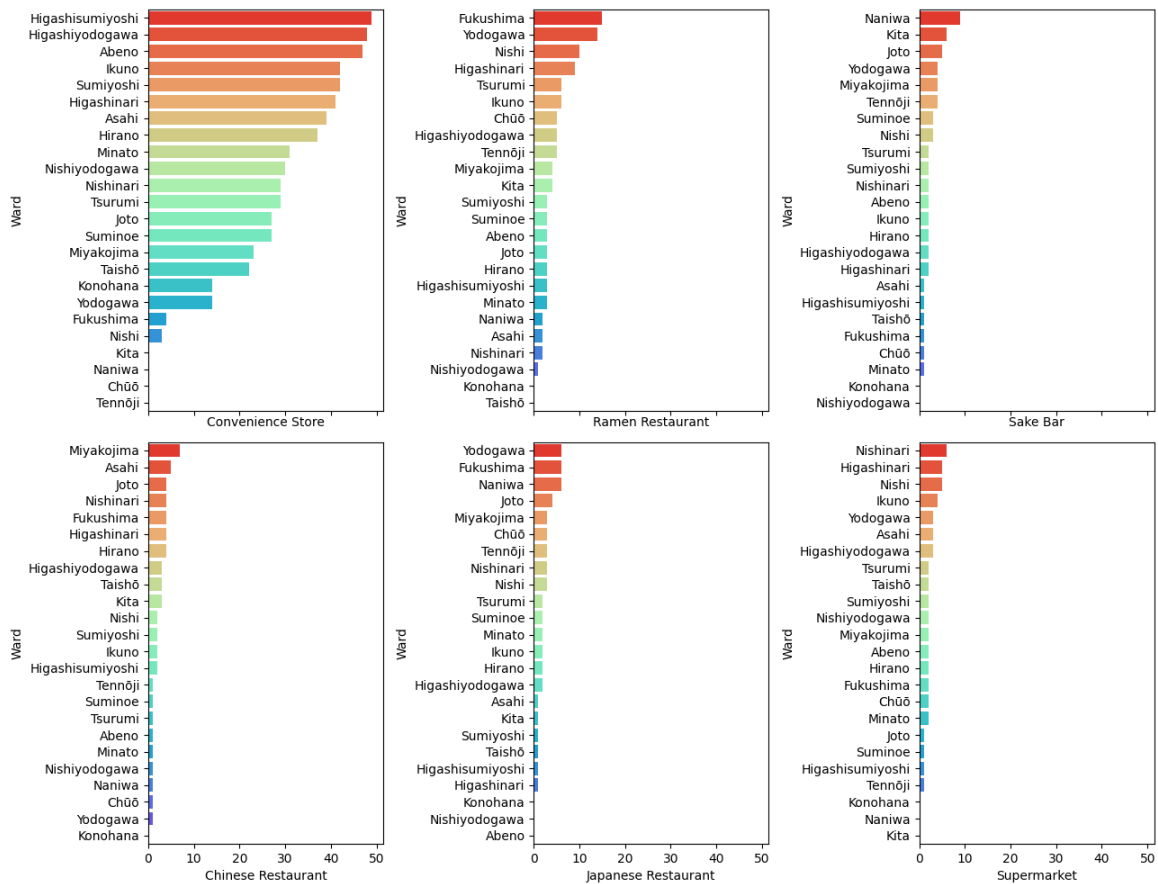


Figure 7. The six most common restaurant categories in each ward.

4.3 K-means clustering results

To get a better view of the Osaka, we decided to use k-means clustering algorithm to analysis the 10 most common restaurants and venues in each ward. The silhouette approach was implemented to determine the optimal number of k-means clusters. As shown in Fig. 8, the highest silhouette score was obtained at $k = 2$ to 5 for the clustering based on venues, and $k = 2$ for the clustering based on restaurants.

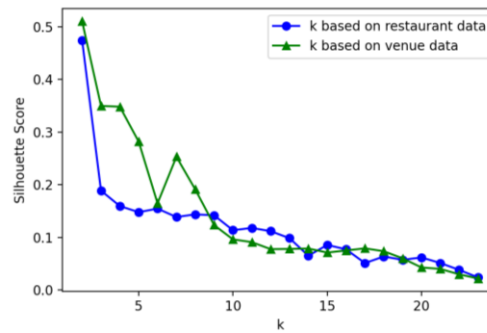


Figure 8. The determination of the optimal number of clusters based on the silhouette approach.

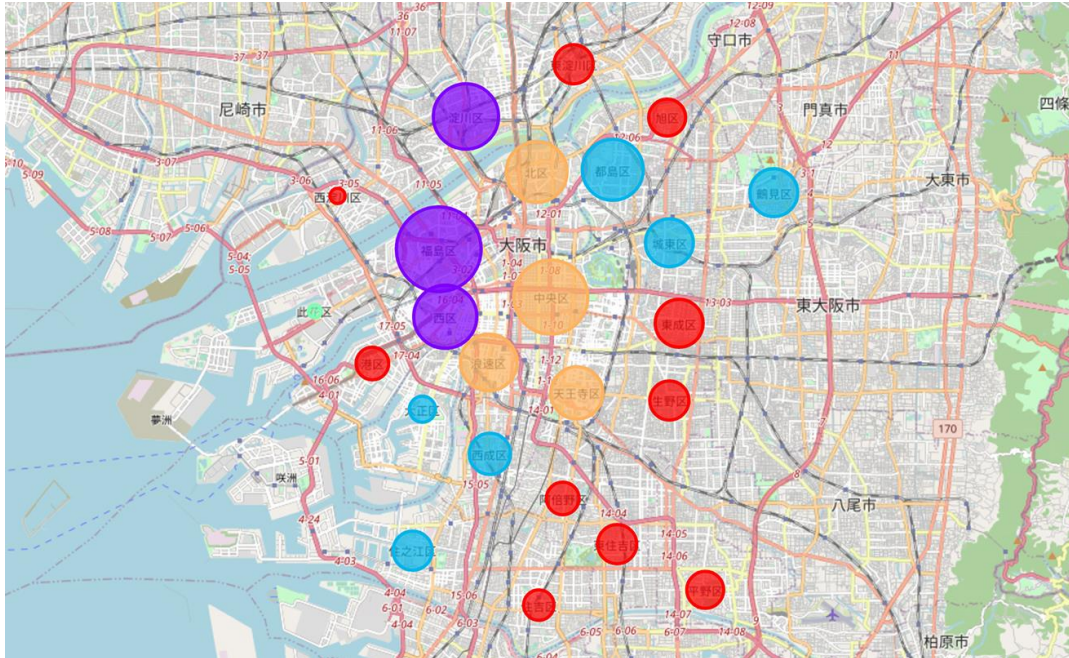


Figure 9. The clustered wards of Osaka on the map.

It was noticed that the clustering results are less informative when k was small. For example, only the ward Konohana was labeled as a different cluster when $k = 2$, which is reasonable since Konohana is a seaside leisure area in Osaka. However, we will need a more detailed classification for these wards to help us understand the similarities and differences of these wards. In addition, some food/drink-related venues may not have the keyword ‘restaurant’ and thus were not included in the restaurant data. Therefore, $k = 5$ was applied for the K-means clustering based on the venue data in this project. As shown in Fig. 9, the wards of Osaka were clustered based on the similarities of venue categories. The radius of the circles represents the number of restaurants in each ward.

5. Discussion section

5.1 Cluster 1

	Wards	Kanji	1st Most Common	2nd Most Common	3rd Most Common	4th Most Common	5th Most Common	6th Most Common	7th Most Common	8th Most Common	9th Most Common	10th Most Common
0	Abeno	阿倍野区	Convenience Store	Soccer Stadium	Park	Ramen Restaurant	Donburi Restaurant	Restaurant	Train Station	Coffee Shop	Fast Food Restaurant	Supermarket
1	Asahi	旭区	Convenience Store	Chinese Restaurant	Sushi Restaurant	Train Station	Supermarket	Donburi Restaurant	Fast Food Restaurant	Discount Store	Ramen Restaurant	Noodle House
4	Higashinari	東成区	Convenience Store	Ramen Restaurant	Supermarket	Chinese Restaurant	Udon Restaurant	Steakhouse	Fast Food Restaurant	Bookstore	Sushi Restaurant	Pizza Place
5	Higashiumiyoshi	東住吉区	Convenience Store	Soccer Stadium	Donburi Restaurant	Ramen Restaurant	Park	Udon Restaurant	Restaurant	Fast Food Restaurant	Clothing Store	Chinese Restaurant
6	Higashiyodogawa	東淀川区	Convenience Store	Train Station	Ramen Restaurant	Donburi Restaurant	Chinese Restaurant	Supermarket	Coffee Shop	Sake Bar	Drugstore	Sushi Restaurant
7	Hirano	平野区	Convenience Store	Chinese Restaurant	Fast Food Restaurant	Intersection	Ramen Restaurant	Donburi Restaurant	Clothing Store	Sushi Restaurant	Furniture / Home Store	Park
8	Ikuno	生野区	Convenience Store	Ramen Restaurant	Donburi Restaurant	Supermarket	BBQ Joint	Pizza Place	Intersection	Steakhouse	Chinese Restaurant	Japanese Restaurant
12	Minato	港区	Convenience Store	Hotel	Ramen Restaurant	Discount Store	Fast Food Restaurant	Train Station	Donburi Restaurant	Restaurant	Takoyaki Place	Supermarket
17	Nishiyodogawa	西淀川区	Convenience Store	Train Station	Grocery Store	Intersection	Clothing Store	Fast Food Restaurant	Furniture / Home Store	Café	Supermarket	Park
19	Sumiyoshi	住吉区	Convenience Store	Ramen Restaurant	Restaurant	Train Station	BBQ Joint	Supermarket	Platform	Chinese Restaurant	Clothing Store	Fast Food Restaurant

Figure 10. The ten most common venues for cluster 1 wards.

There are 10 wards in cluster 1 (Red circles in Fig. 9). One of the common attributes of these wards is that they all have a lot of convenience stores. Among these wards, **Abeno** is probably the most famous

one because of the skyscraper - Abeno Harukas. According to Fig. 5 and Fig. 10, the Donburi Restaurants are commonly found in **Higashisumiyoshi** and **Higashiyodogawa**, although these two wards may be a little far from the most common tourist attractions and well-known shopping malls in Osaka.

5.2 Cluster 2

Three wards including **Fukushima**, **Nishi** and **Yodogawa** were clustered as the cluster 2 (purple circles in Fig. 9). As we discussed previously, **Fukushima** has the highest number of restaurants (49) among all wards, while **Nishi** and **Yodogawa** have 33 and 38 restaurants, respectively. It was noticed that almost all common venues in these wards are related to food and drink (Fig. 11). In addition to the traditional Japanese restaurants (i.e. Ramen and Sushi restaurants), Café, Pizza places, Italian restaurants and Dessert shops can also be commonly found here.

	Wards	Kanji	1st Most Common	2nd Most Common	3rd Most Common	4th Most Common	5th Most Common	6th Most Common	7th Most Common	8th Most Common	9th Most Common	10th Most Common
3	Fukushima	福島区	Ramen Restaurant	Japanese Restaurant	Café	Convenience Store	Pizza Place	Chinese Restaurant	Italian Restaurant	Japanese Curry Restaurant	BBQ Joint	Bakery
15	Nishi	西区	Ramen Restaurant	Supermarket	Café	Train Station	Dessert Shop	Shopping Mall	Japanese Curry Restaurant	Japanese Restaurant	Sushi Restaurant	Sake Bar
23	Yodogawa	淀川区	Convenience Store	Ramen Restaurant	Japanese Restaurant	Sake Bar	Discount Store	Supermarket	Japanese Curry Restaurant	Coffee Shop	Donut Shop	Café

Figure 11. The ten most common venues for cluster 2 wards.

5.3 Cluster 3

There are 6 wards in cluster 3 (blue circles in Fig. 9). As shown in Fig. 7 and Fig. 12, the Chinese food restaurants and Fast Food restaurants are commonly found in these 6 wards. Although both Chinese food and fast food may not be good choices for people to get in touch with the Japanese culture, some tourists may want to explore if there are any differences between these food in Japan and those in the other countries.

	Wards	Kanji	1st Most Common	2nd Most Common	3rd Most Common	4th Most Common	5th Most Common	6th Most Common	7th Most Common	8th Most Common	9th Most Common	10th Most Common
9	Joto	城東区	Convenience Store	BBQ Joint	Sake Bar	Fast Food Restaurant	Coffee Shop	Chinese Restaurant	Japanese Restaurant	Restaurant	Ramen Restaurant	Shopping Mall
13	Miyakojima	都島区	Convenience Store	Chinese Restaurant	Sushi Restaurant	Ramen Restaurant	Sake Bar	Discount Store	Café	BBQ Joint	Japanese Restaurant	Grocery Store
16	Nishinari	西成区	Convenience Store	Supermarket	Furniture / Home Store	Chinese Restaurant	Discount Store	Japanese Restaurant	Grocery Store	Udon Restaurant	Fast Food Restaurant	Shopping Mall
18	Suminoe	住之江区	Convenience Store	Donburi Restaurant	Fast Food Restaurant	Sake Bar	Sushi Restaurant	Ramen Restaurant	Video Store	Pier	Platform	Park
20	Taishō	大正区	Convenience Store	Donburi Restaurant	Bus Stop	Golf Driving Range	Chinese Restaurant	Park	Sushi Restaurant	Supermarket	Fast Food Restaurant	Grocery Store
22	Tsurumi	鶴見区	Convenience Store	Ramen Restaurant	Coffee Shop	Sushi Restaurant	Donburi Restaurant	Fast Food Restaurant	Udon Restaurant	Sake Bar	Italian Restaurant	Clothing Store

Figure 12. The ten most common venues for cluster 3 wards.

5.4 Cluster 4

Konohana was categorized as the only ward in cluster 4 (green circles in Fig. 9) since it is a well-known seaside leisure area. **Konohana's** most famous place is the Universal Studios Japan. If you enjoy visiting the theme park, it is definitely worth a try for the highly rated American restaurant in **Konohana** after having a visit to the Universal Studios.

	Wards	Kanji	1st Most Common	2nd Most Common	3rd Most Common	4th Most Common	5th Most Common	6th Most Common	7th Most Common	8th Most Common	9th Most Common	10th Most Common
11	Konohana	此花区	Theme Park Ride / Attraction	Convenience Store	Intersection	Gift Shop	Theme Park	Hotel	American Restaurant	Café	Harbor / Marina	Pizza Place

Figure 13. The ten most common venues for cluster 4 ward.

5.5 Cluster 5

Four wards, including **Chūō**, **Kita**, **Naniwa** and **Tennōji** were assigned as cluster 5 (orange circles in Fig. 9). In fact, these four wards are Osaka's financial administration centers. There are lots of shopping and tourist areas in these wards, as well as many good restaurants (Fig. 14). **Chūō** has the second highest number of restaurants among all wards (Fig. 6), and it is a good choice if you are interested in dining in Japanese curry or Ramen restaurants after visiting the well-known Dōtonbori and Shinsaibashi districts. Osaka Castle, as one of Japan's most famous landmarks is also located in the **Chūō**.

	Wards	Kanji	1st Most Common	2nd Most Common	3rd Most Common	4th Most Common	5th Most Common	6th Most Common	7th Most Common	8th Most Common	9th Most Common	10th Most Common
2	Chūō	中央区	Japanese Curry Restaurant	Coffee Shop	Ramen Restaurant	Bakery	Rock Club	Japanese Restaurant	Yoshoku Restaurant	Café	Asian Restaurant	Hotel
10	Kita	北区	Café	Sake Bar	Dessert Shop	Ramen Restaurant	Bar	Japanese Curry Restaurant	BBQ Joint	Pub	Udon Restaurant	Kushikatsu Restaurant
14	Naniwa	浪速区	Sake Bar	Japanese Restaurant	Coffee Shop	Café	Udon Restaurant	BBQ Joint	Yoshoku Restaurant	Rock Club	Thai Restaurant	Bookstore
21	Tennōji	天王寺区	Electronics Store	Okonomiyaki Restaurant	Kushikatsu Restaurant	Ramen Restaurant	Café	Hotel	Bar	Sake Bar	Hobby Shop	Japanese Curry Restaurant

Figure 14. The ten most common venues for cluster 5 ward.

Kita and **Naniwa** are both shopping paradise in Osaka, and you can easily find a lot of well-known Sake Bar in these areas. By the way, if you are interested in Japanese anime and video game, don't miss the anime street in Nipponbashi, which is located between **Naniwa** and **Chūō**. **Tennōji** is famous for many Attractions such as Shitenō-ji Temple and Isshin-ji. The transportation in this area is extremely convenient. As shown in Fig. 14, **Tennōji** is probably the best place to try the Osaka-style Okonomiyaki and Kushikatsu.

5.6 Limitations of this project

Unfortunately, although the venue limit per area was set to 200, only up to 100 venues can be obtained for each location according to the Foursquare API. Therefore, it is important to define smaller regions in each ward to get more complete venue information in the future study.

This project used common venues to analyze different wards in Osaka. However, qualities are often more important than quantities, although quantity may reflect the quality in some respects due to the intensive competition in the Japanese food and drink industry. It may be more convincing to include the customer's rating in the future study.

6. Conclusion

In this project, data science methodology was used to create a simple foodie's guide to Osaka. Osaka is a

city with passionate food lovers and an abundance of things to eat, and this study is just a small glimpse of the Osaka food culture. If you are going to visit Japan for the first time, don't forget to explore the fantastic Japanese food culture in Osaka.

References

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