

Battle of Neighborhoods

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Introduction

Tourism is a popular industry to develop local economics in the world. It provides governments with several benefits, including boosting the economy's revenue, investing thousands of jobs, and evolving countries' infrastructures. Hence, governments are enthusiastic about attracting more and more tourists to visit their country, which requires presenting safe and advanced facilities. Furthermore, tourism leads to entrepreneurs' opportunities to establish new products and services that would not be sustainable for the local population of residents alone. Therefore, residents also experience tourist destinations' advantages in their own country (Yehia, 2019.)

In 2019, it was estimated that the number of international tourist arrivals worldwide would reach approximately 1.46 billion while there were 35.4 million tourist arrivals in hotels in Paris. It is one of the most visited cities in Europe attracts millions of visitors from abroad or France. It appears that French tourists are discovering Paris as same as internationals. However, international visitors are more than French ones and spend more on food and drink as well as shopping than French. Moreover, visiting museums and monuments possesses the most significant proportion of French and foreign tourists' holiday motivations (Statista Research Department, 2020.)

Lan Xue and Yi Zhang have investigated the effect of distance on tourist behavior. The study explored tourists' behavioral patterns in three groups: long-haul tourists, short-haul tourists, and local visitors who visited Suzhou, China, from April 2012 to October 2013. It results in different motivations behind trips. Local visitors are keen on relaxation and shopping. They are interested in theme hotels and hostels and less enthusiastic about local foods. While Short-haul tourists mixed relaxation with sightseeing, such as visit cultural heritage, famous sites, and favored high-end hotels and restaurants. On the other side, Long-haul tourists principally visited Suzhou for sightseeing and seeking product features and qualities because they consider it a once-in-a-lifetime trip (Lan Xue and Yi Zhang, 2020.)

According to several trips' motivations, book a hotel based on the intention helps tourists save time and assets. Short-haul tourists enjoy high-end hotels in a neighborhood close to top-ranked restaurants, while long-haul tourists are keen to accommodate nearby museums and attractions. So, the question is which hotel and which neighborhood satisfy visitors' various motivations? Therefore, this article focused on supporting visitors to book the fittest hotel in Paris by clustering neighborhoods based on time distance to attractions, restaurants, and shopping malls. It satisfies visitors to choose the best neighborhood and makes stakeholders like the government, restaurant managers, and hotel managers alliances to invest in a particular region.

Data Collection

Paris is the most exciting place with an endless array of sites, activities and a vast selection of hotels. Most of these hotels are located around the main attractions such as Eiffel Tower, Champs Elysees, or Louvre. This article considers ninety-nine hotels in the capital of France. Foursquare API extracts hotels locating less than twenty kilometers from Paris. The API response provides Hotels' attributes such as name, rate, and geographical coordinates. Foursquare places API enables access to global POI data from over 100K trusted sources. It provides real-time data access, which discovers and ranks venues.

Table 1: List of hotels

	Id	Name	Latitude	Longitude	Rate
0	560ac500498e8ff36b2be81d	Hôtel Providence	48.869283	2.356851	9.1
1	599f10d89b04730cde6d8bf4	The Hoxton Paris	48.870179	2.346632	9.1
2	505ec24de4b011bf1f426e58	Hotel Atmospheres	48.848695	2.348145	8.8
3	53b65301498e8cb57224f80c	Hôtel Ritz	48.868145	2.328962	9.4
4	4adcda00f964a520de3021e3	Hôtel d'Aubusson	48.854729	2.339505	8.7
...
94	5bd97fb41fa763002cbcf8ba	Hôtel Brach	48.861217	2.275082	8.1
95	4c5b3ef07f661b8ddf73451c	Ibis Bastille - Faubourg St-Antoine	48.851802	2.378642	7.7
96	4bc9a6d7fb84c9b6215d1b3e	Étoile Saint Honoré by HappyCulture	48.875651	2.304157	7.9
97	59254c3a9e0d54127012e45f	citizenM Paris la Défense	48.894040	2.229927	9.3
98	5984512af5e9d7171635e0e9	Hôtel National des Arts et Métiers	48.865812	2.353347	7.5
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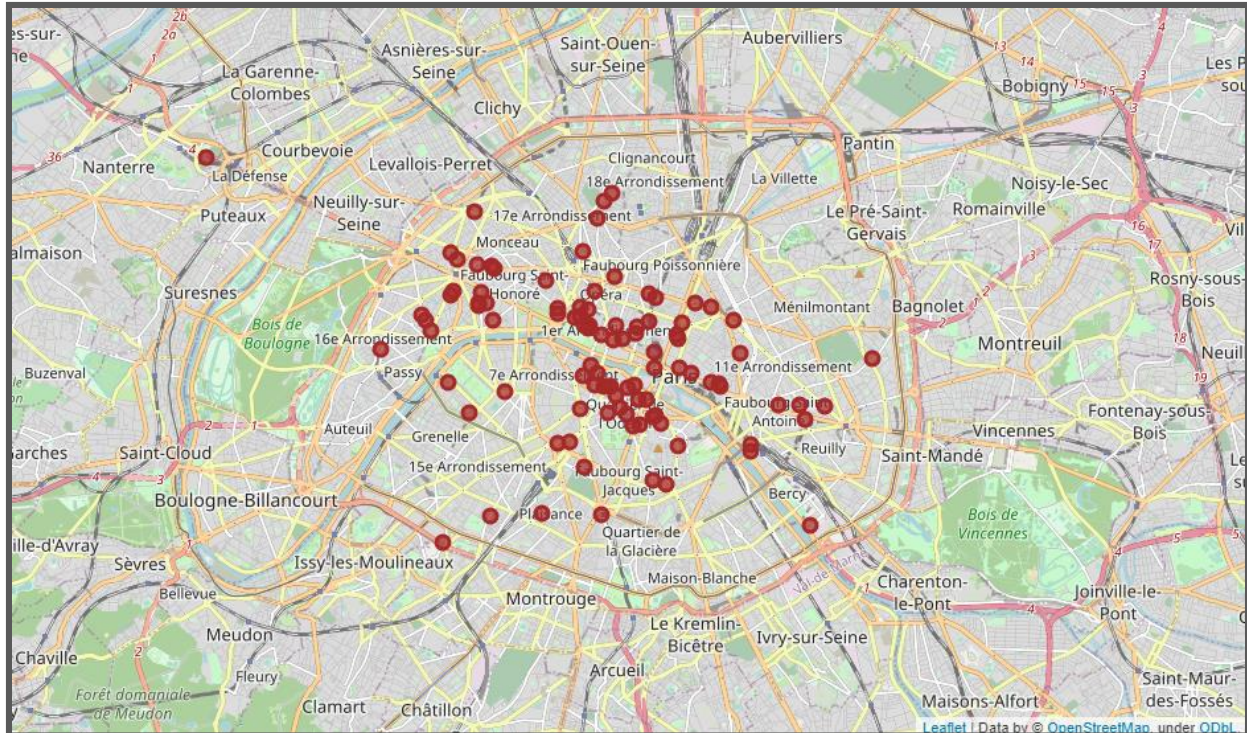


Figure 1: Hotels are landmarked in Paris Map

Annually thirty million foreign tourists visit Paris's sights include monuments and architecture such as Arc de Triomphe, neo-classic Haussmannian boulevard, buildings as well as museums, operas and concert halls. With its many monuments, Paris is a symbol of French culture. Therefore, nineteen top tourist attractions and twenty top-ranked restaurants are chosen from the Tripadvisor website that is the world's largest travel platform that supports millions of travelers. Tripadvisor website presents millions of reviews and opinions of millions of restaurants, accommodations, airlines and cruises. It is the best platform to compare venues, flights, tours and attractions.

Paris competes with other cities such as New York, London, and Milan to be among the most remarkable fashion capitals. So it is a best place for shopping. There is a list of the best shopping centers, Malls, boutiques, and second-hand clothes stores in and around Paris, which is ranked by the France-hotel-guide website. It is an online booking website since 1996 that organizes travel around events and the visit of iconic places. Therefore, it has gathered information about venues that might be interesting to travelers. The top five shopping malls are considered that tourists are immensely eager to visit.

Data collecting in three categories is expressed in the following tables. All geographical coordinates of venues in tables are extracted by the Geopy package in python.

Table 2: List of tourist attractions

	Name	Category	Price	TIME TO SPEND	Value	Facilities	Atmosphere	Latitude	Longitude
0	Cathedrale de Notre Dame de Paris	Turist Attraction	Free	2 hours to Half Day	5.0	4.0	4.5	48.8529	2.3501
1	Musée du Louvre	Turist Attraction	15 euros	Half Day to Full Day	4.5	4.5	4.5	48.8611	2.3380
2	Eiffel Tower	Turist Attraction	17 euros	1 to 2 hours	4.5	4.5	4.5	48.8583	2.2945
3	Jardin des Tuileries	Turist Attraction	Free	1 to 2 hours	5.0	3.0	5.0	48.8637	2.3268
4	Le Marais	Turist Attraction	Free	2 hours to Half Day	5.0	4.5	4.5	48.8604	2.3607
5	Sacré-Cœur	Turist Attraction	Free	2 hours to Half Day	5.0	4.0	4.5	48.8868	2.3430
6	Musée d'Orsay	Turist Attraction	12 euros	2 hours to Half Day	4.0	4.5	5.0	48.8599	2.3266
7	Musee de l'Orangerie	Turist Attraction	6 euros	1 to 2 hours	4.0	4.5	4.0	48.8638	2.3227
8	Pere-Lachaise Cemetery	Turist Attraction	Free	1 to 2 hours	5.0	0.0	4.0	48.8612	2.3939
9	Palais Garnier - Opera National de Paris	Turist Attraction	11 euros	1 to 2 hours	4.0	4.0	4.5	48.8714	2.3320
10	Luxembourg Gardens	Turist Attraction	Free	1 to 2 hours	5.0	2.0	5.0	48.8462	2.3345
11	Arc de Triomphe	Turist Attraction	8 euros	1 to 2 hours	4.0	3.5	4.5	48.8738	2.2950
12	Versailles Palace	Turist Attraction	18 euros	Half Day to Full Day	4.0	3.5	4.0	50.8486	4.3509
13	Musée Rodin	Turist Attraction	10 euros	2 hours to Half Day	4.5	4.0	4.5	48.8547	2.3159
14	Centre Pompidou	Turist Attraction	14 euros	2 hours to Half Day	4.0	4.0	3.5	48.8606	2.3525
15	Paris Catacombs	Turist Attraction	12 euros	1 to 2 hours	4.0	0.0	3.5	48.8337	2.3323
16	Champs-Élysées	Turist Attraction	Free	1 to 2 hours	5.0	3.5	4.0	48.8708	2.3053
17	Sainte-Chapelle	Turist Attraction	15 euros	Less than 1 hour	4.0	3.0	4.0	48.8554	2.3450
18	Galleries Lafayette Paris Haussmann	Turist Attraction	Free	1 to 2 hours	5.0	4.0	4.0	48.8736	2.3321

Table 3: List of shopping malls

	Name	Category	Shop Range	Latitude	Longitude
0	Le Bon Marché	Shopping Mall	High	48.8513	2.3244
1	Beaugrenelle Paris shopping mall	Shopping Mall	High	48.8488	2.2827
2	Le Carrousel du Louvre	Shopping Mall	High	48.8629	2.3348
3	Forum des Halles	Shopping Mall	Medium	48.8623	2.3447
4	Italie Deux	Shopping Mall	Medium	48.8293	2.3552

Table 4: List of restaurants

	Name	Category	Price	Details	Latitude	Longitude
0	Brasserie Cézanne	Restaurant	Medium	French, Seafood, Mediterranean	48.8689	2.2912
1	Il Etait Un Square	Restaurant	Medium	French, Steakhouse, European	48.8323	2.3476
2	Mayfair Garden Paris	Restaurant	High	Indian, Contemporary, Healthy	48.8650	2.2896
3	Boutary	Restaurant	High	French, Seafood, European	48.8560	2.3379
4	La Table de Colette	Restaurant	High	French, European, Healthy	48.8474	2.3472
5	Baoli Bao	Restaurant	Low	Asian, Fusion, Healthy	48.8769	2.3486
6	Joyti Restaurant	Restaurant	Medium	Indian, Vegetarian Friendly, Vegan Options	48.8439	2.3152
7	Bistrot Kinzo	Restaurant	High	Japanese, Healthy, Japanese Fusion	48.8721	2.3459
8	Via Emilia	Restaurant	Medium	Italian, Mediterranean, European	48.8798	2.3352
9	Pur' - Jean-Francois Rouquette	Restaurant	High	French, European, Vegan Options	48.8690	2.3302
10	O'Bergine	Restaurant	Medium	French, Lebanese, Healthy	48.8649	2.3481
11	Bistrot Instinct	Restaurant	Medium	French, European, Healthy	48.8639	2.3625
12	Domenico's	Restaurant	Medium	Italian, Mediterranean, Campania	48.8770	2.3383
13	Epicure	Restaurant	High	French, European, Vegetarian Friendly	48.8726	2.3154
14	La MiN	Restaurant	Medium	French, International, European	48.8508	2.3154
15	Les Apotres de Pigalle	Restaurant	Medium	Brew Pub, European, South American	48.8832	2.3364
16	Chez Pitou	Restaurant	Medium	French, European, Healthy	48.8904	2.3344
17	Madito	Restaurant	Medium	Lebanese, Mediterranean, Middle Eastern	48.8514	2.3801
18	India StreEAT	Restaurant	Medium	Indian, Healthy, Street Food	48.8405	2.3518
19	Frog & Underground	Restaurant	Medium	American, Brew PubBar	48.8713	2.3431
20	ASPIC	Restaurant	High	French, European, Contemporary	48.8793	2.3437

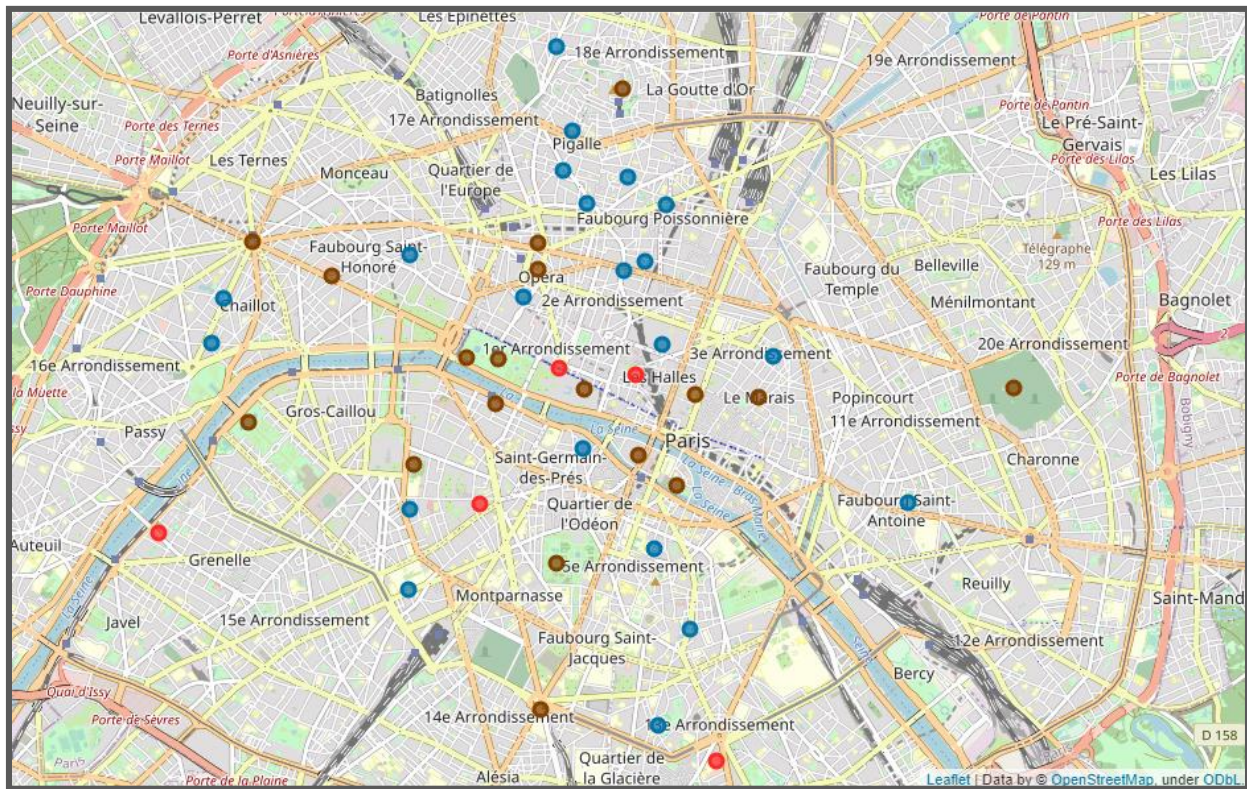


Figure 2: Restaurants, attractions, and shopping malls are landmarked by blue, brown, and pink points, respectively

Methodology

Forty-four venues in three distinct categories encourage tourists to visit Paris. One or more categories might be the purpose of travel, so an intelligent booking would be more lucrative by choosing a hotel located in a neighborhood close to the targets. Hence, the distances between hotels and categories are estimated by Bing Map API to help travelers in selecting the fittest hotel. The API extracts time durations based on car driving and public transportations that most tourists utilize. Regarding time duration, hotels are clustered by K-mean algorithm into distinct neighborhoods enabling conscious decision-making options.

K-mean clustering is one of the popular unsupervised machine learning algorithms. Clustering refers to gathering samples based on certain similarities using only input vectors without considering labelled and outcomes. Accordingly, it is a useful method to bunch hotels by time durations to venues, providing travelers with a spacious booking choice.

Reaching optimized clusters depends on executing four steps, investigating in the following paragraphs.

Step1: Calculating the distance between hotels and attractive venues

The Bing Maps REST Service is an effective routing service that allows developers to calculate and optimize routes for several modes such as driving, walking, and public transit with traffic information included. In this step, time durations to charming venues are extracted per second for each hotel in two modes (driving and public transit.) The JSON response from Bing Maps API is presented in the table below.

Table 5: Time Durations per second

						Transit to Cathédrale de Notre Dame de Paris	Transit to Musée du Louvre	Transit to Eiffel Tower	Transit to Jardin des Tuileries	Transit to Le Marais	...	Driving to Chez Pitou	Driving to Madito	Driving to India StreEAT
0	560ac500498e8ff38b2be81d	Hôtel Providence	48.869283	2.356851	9.1	981	1019	1684	1006	707	...	947	803	1003
1	569f10d89b04730cde8d8bf4	The Hoxton Paris	48.870179	2.346632	9.1	1124	1282	1655	931	809	...	718	910	1017
2	505ec24de4b011bf1f426e58	Hotel Atmospheres	48.848895	2.348145	8.8	489	955	1929	1260	1216	...	1286	723	187
3	53b65301498e8cb57224f80c	Hôtel Ritz	48.868145	2.328962	9.4	1147	908	1380	435	1250	...	743	1141	940
4	4ad0da00f664a520de3021e3	Hôtel d'Aubusson	48.854729	2.339505	8.7	683	619	1851	1273	1161	...	1092	999	526
...
94	5bd97fb41fa763002c0cf8ba	Hôtel Brach	48.861217	2.275082	8.1	1729	1603	1358	1475	2108	...	987	1516	1282
95	4c5b3ef07f6b1b8ddf73451c	Ibis Bastille - Faubourg St- Antoine	48.851802	2.378642	7.7	1291	1673	2063	1546	807	...	1482	24	582
96	4bc9a6d7fb84c9b6215d1b3e	Étoile Saint Honoré by HappyCulture	48.875651	2.304157	7.9	1549	1234	1393	1043	1670	...	717	1381	1167
97	59254c3a9e0d54127012e45f	citizenM Paris la Défense	48.894040	2.229927	9.3	2220	1905	2081	1714	2341	...	1216	1941	1852
98	5984512af5e9d7171635e0e9	Hôtel National des Arts et Métiers	48.865812	2.353347	7.5	751	1486	1675	1069	727	...	923	679	708
99 rows x 95 columns														

Step2: Data Scaling

Feature Scaling is one of the essential parts of machine learning algorithms. It is a technique to standardize the independent features, operating to handle high magnitudes or values. If feature scaling is not executed, machine learning algorithms assign greater weights to higher values and smaller weights to lower values, regardless of the values' unit. Hence, time duration data is scaled by the Standard Scaler method to be prepared for clustering.

Table 6: Output of Standard Scaler

	Transit to Cathedrale de Notre Dame de Paris	Transit to Musée du Louvre	Transit to Eiffel Tower	Transit to Jardin des Tuileries	Transit to Le Marais	Transit to Sacré- Cœur	Transit to Musée d'Orsay	Transit to Musée de l'Orangerie	Transit to Père- Lachaise Cemetery	Transit to Palais Garnier - Opera National de Paris	...	Driving to Chez Pitou	Driving to Madito	Driving to India StreEAT	Drivi Fi Undergr
0	-0.393683	-0.103122	0.451017	-0.019623	-1.257923	0.742795	0.649623	-0.492313	-1.123509	-0.701142	...	-0.228104	-0.568969	0.682774	-0.23
1	-0.010218	0.616137	0.377457	-0.232638	-1.035781	-0.129324	1.543203	-0.715381	-1.158152	-1.309663	...	-1.040061	-0.246510	0.726539	-1.50
2	-1.504083	-0.278151	1.072469	0.701787	-0.149392	0.850430	-0.018684	1.098909	0.804288	1.555600	...	0.973875	-0.810060	-1.868084	0.15
3	0.043890	-0.406688	-0.320091	-1.641376	-0.075345	-0.844130	-0.559337	-1.179363	-0.679259	-1.462663	...	-0.951419	0.449641	0.485833	-1.21
4	-1.047690	-1.197052	0.874619	0.738710	-0.269175	0.538565	-0.299023	1.122703	0.690169	-0.388189	...	0.286017	0.021704	-0.808353	-0.11
...
94	1.413071	1.494015	-0.375895	1.312430	1.793258	1.424483	0.441872	0.875840	1.040678	1.326101	...	-0.086278	1.579756	1.554942	1.47
95	0.382657	1.685453	1.412365	1.514084	-1.040137	1.418963	1.550712	1.113780	-1.123509	0.828853	...	1.668825	-2.916595	-0.633294	1.27
96	0.989613	0.484865	-0.287116	0.085464	0.839356	-0.661978	0.181558	-0.099712	0.814477	0.328127	...	-1.043607	1.172915	1.195446	0.02
97	2.568169	2.319932	1.458023	1.991237	2.300700	1.968177	1.898632	1.896006	2.756539	1.100079	...	0.725679	2.860554	3.336791	3.00
98	-0.887717	1.174041	0.428188	0.159309	-1.214366	-0.239718	1.027580	0.031154	-1.800071	-1.267936	...	-0.313200	-0.942661	-0.239411	-1.23

99 rows x 90 columns

Step3: Optimize number of clusters

The Elbow method is a beneficial technique for exploring the optimum number of clusters. It runs K-mean clustering algorithm for approximately ten times and computes all clusters' averages scores for each iteration. Accordingly, it claims the best number of clusters for the dataset. The Elbow method is utilized in this article to calculate the number of neighborhoods.

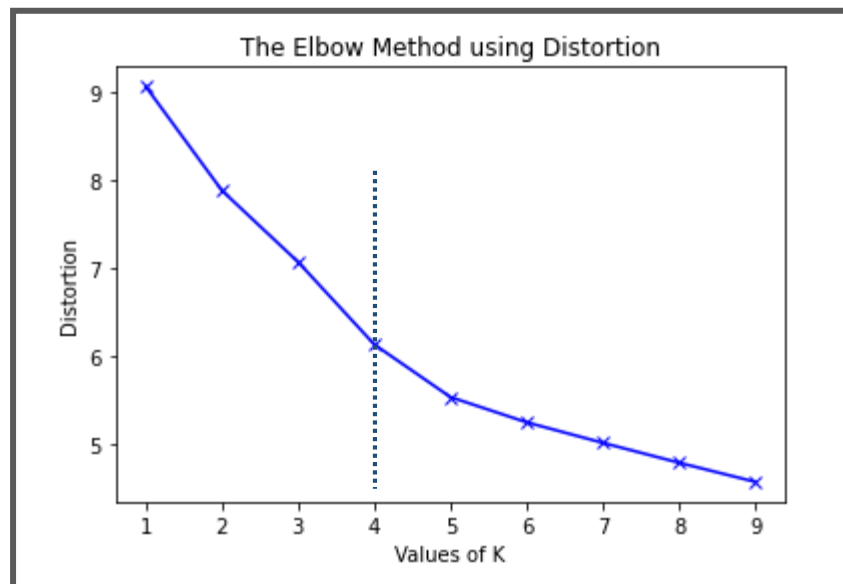


Figure 3: Optimum number of clusters measuring by Elbow method

Step4: Apply K-mean Clustering algorithm

By Applying the K-mean clustering algorithm into data, hotels are investigated by similarity in features. Consequently, the unsupervised algorithm turns four neighborhoods include hotels with the same time distance to attractive venues, providing tourists with a list of hotels establishing in a particular borough and meet their desires.

Table 7: Output of K-mean clustering algorithm

Cluster Number		Id	Name	Latitude	Longitude	Rate	Transit to Cathedrale de Notre Dame de Paris	Transit to Musée du Louvre	Transit to Eiffel Tower	Transit to Jardin des Tuileries	...	Driving to Chez Pitou	Driving to Madito	Driving to India StreEAT
0	0	560ac500498e8ff36b2be81d	Hôtel Providence	48.869283	2.356851	9.1	961	1019	1684	1006	...	947	803	1003
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4	1	4adcdca00f964a520de3021e3	Hôtel d'Aubusson	48.854729	2.339505	8.7	683	619	1851	1273	...	1092	999	526
...
94	2	5bd97fb41fa763002cbcf8ba	Hôtel Brach	48.861217	2.275082	8.1	1729	1603	1358	1475	...	987	1516	1282
95	3	4c5b3ef07f661b8ddf73451c	Ibis Bastille - Faubourg St-Antoine	48.851802	2.378642	7.7	1291	1673	2063	1546	...	1482	24	582
96	2	4bc9a6d7fb84c9b6215d1b3e	Étoile Saint Honoré by HappyCulture	48.875651	2.304157	7.9	1549	1234	1393	1043	...	717	1381	1167
97	3	59254c3a9e0d54127012e45f	citizenM Paris la Défense	48.894040	2.229927	9.3	2220	1905	2081	1714	...	1216	1941	1852
98	0	5984512af5e9d7171635e0e9	Hôtel National des Arts et Métiers	48.865812	2.353347	7.5	751	1486	1675	1069	...	923	679	708
99 rows x 96 columns														

By executing step four, clusters would be extracted based on all features, including time durations to tourist attractions, restaurants, and shopping centers, which ultimately comply with the article's goal to support short-haul travelers who are not only willing to relax at top high-end hotels and restaurants also interested in seeking cultures and buildings. Likewise, it is necessary to define clusters based on specific features that attract long-haul visitors who spend less time shopping plus local travelers who are enthusiastic about fun, shopping malls, theme hotels, and restaurants (Lan Xue and Yi Zhang, 2020.) Results of clustering are illustrated in the following section.

Average Time Duration	
Red Cluster	980.003425
Purple Cluster	1060.584256
Yellow Cluster	1147.895412
Green Cluster	1650.260762

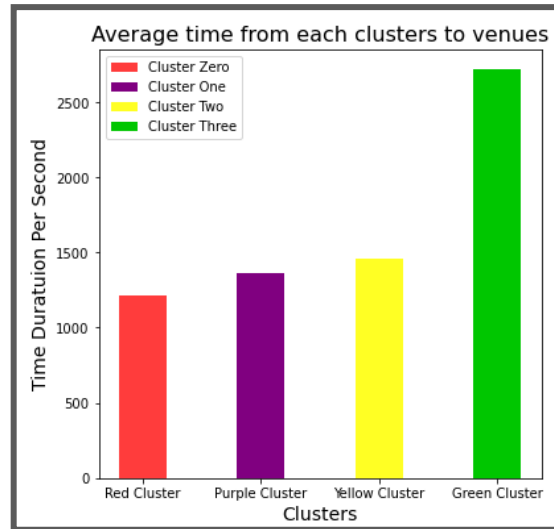


Figure 5: Average time duration required to arrive at all venues from each clusters (per second)

Clusters have been sorted by time distance to all venues, as shown in Table 8. It seems that the red cluster is the best choice for visitors, while it is not sufficiently precise yet. Accordingly, it is necessary to compare time durations from clusters to venues of travelers' targets. It would result in excellent guidance to recommend hotels.

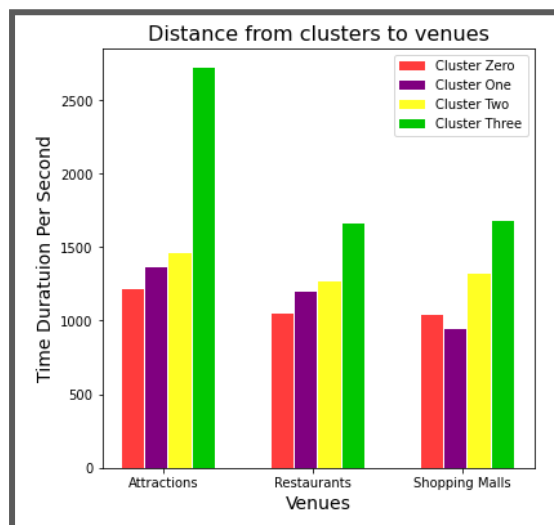


Figure 6: Average time duration required to arrive at each category of venues from clusters (per second)

Table 9: Average time duration required to arrive at each category of venue clusters (per second)

	Attractions	Restaurants	Shopping Malls
Red Cluster	1224.218045	868.584354	905.994286
Purple Cluster	1313.951613	995.701997	788.493548
Yellow Cluster	1388.390351	1047.251984	1109.695833
Green Cluster	2169.757310	1398.587302	1387.055556

Calculating the distance to each category of venues includes attractions, restaurants, and shopping malls, results in the following recommendations

Hotels in the red cluster have been immensely recommended to travelers who travel to Paris for a short time to visit the city's aesthetic heritage, have leisure and release tensions. As this group of travelers are keen to access popular restaurants, grand shopping malls, and popular galleries and museums, the red cluster is the most suitable selection because of the closest distance to tourist attractions and restaurants and a reasonable distance shopping mall.

Likewise, as figure 6 claims, the red points are also the most suitable options for long-haul travelers who are enthusiastic about cultures, history, local foods, features, and qualities, while it is not the perfect decision for local visitors profoundly eager to spend more in shopping malls and relaxations.

Local visitors who travel for leisure are more enthusiastic about the outlets, shopping centers and top restaurants and cafes. Furthermore, they are less interested in museums and tourist attractions they have visited before for times, so it is required to recommend hotels close to the venues in the category of shopping malls and restaurants. Hence, the fittest cluster to this group is purple hotels located approximately thirteen minutes far from shopping malls and fifteen minutes on average to most top restaurants in Paris.

The Green segment might be the appropriate opportunity for business trips, but it can not be an excellent tourist arrangement. Hotels in this cluster are located almost thirty-five minutes far from tourist attractions and popular facilities, leading to wasting visitors' assets. In comparison, the yellow cluster is more reasonable, with an average of less than twenty-five minutes far from attractions, restaurants, and shopping malls.

Conclusion

This article focuses on visitors and their travel purposes to help tourists make the most appropriate hotel booking. Hence, in Paris, the most populous city in France, Hotels are clustered based on the time duration required to arrive at tourist attractions, restaurants, and shopping malls, resulting in four lists of hotels suggesting to visitors. By recommendation of a list of fittest hotels to visitors, they could concentrate on other favor features for their accommodation, regardless of location. Accordingly, it is significantly beneficial for visitors who confront a city they have never been visited and are not familiar with its public transportation, attractions, venues' locations, and directions.

Furthermore, by determining clusters, stakeholders investigate boroughs with the most demands from visitors to invest in conducting hotels, restaurants, theme parks, or other related tourists.

Finally, it would be more useful if tourist leader websites such as Tripadvisor, booking.com consider this location clustering in their hotel ranking, providing tourists with more clear choices.

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