

Capstone Battle of Neighbourhoods: Pharmacies in Lausanne

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Introduction

For an investor in pharmacy business, it is important to keep optimizing the network / chain of pharmacies to improve Return on Investment (ROI).

The location of pharmacies is very important for this pharmacy's ROI. Number of factors such as proximity to hospitals and high-traffic venues such as train stations and popular shops can influence business success of a given pharmacy. For example, proximity to hospitals can drive high traffic of out-patients to a nearby pharmacy to fulfil prescription. Proximity to train stations, metro stations and high traffic shops can also increase the flow of out-patients and especially caregivers such as family members to a pharmacy. Availability of other competing pharmacies in the neighbourhood is also a very important consideration. High density of pharmacies makes it challenging to compete and risks to reduce ROI. The local aspect of pharmacy business model is also an important considering for selecting a location: patients or family members with prescription for an acute illness, such as one's child's otitis, or elderly patients with chronic diseases are unlikely to travel to high-traffic locations to fulfil their prescription and therefore need access to a pharmacy in their residential neighbourhood / community.

The analysis of the pharmacies density and neighbourhoods can help investors to make a better data-driven decision on where to open new pharmacy or optimize existing assets (for example, consolidate pharmacies in high-density areas) to improve ROI. The focus of this project is to inform investors decision on opening a pharmacy in Lausanne, Switzerland.

Data

Lausanne is the capital city and biggest city of the canton (state) of Vaud, Switzerland. Lausanne has an area of approximately 41 square kilometres. With the population of about 140,000, it is the fourth largest city in Switzerland.

The data used to solve the problem outlined in this project is geolocation data on pharmacies in Lausanne collected from FourSquare. As Lausanne is located in a French-speaking region of Switzerland, the queries were adapted to search names in French. The search resulted in 50

pharmacies. Data on pharmacies is a dataframe containing at least a location of each pharmacy.

Out[222]:

	name	categories	address	lat	lng	labeledLatLngs	distance	cc	city	state	country	formattedAddress	postalCode	crossStreet	id
0	Pharmacie 24	Pharmacy	Montchoisi	46.514192	6.633228	[[{"label": "display", "lat": 46.51419195693392, "lng": 6.633228}]]	850	CH	Lausanne	Vaud	Suisse	[Montchoisi, Lausanne]	NaN	NaN	4e7236c2b99345b6e8627db
1	Pharmacie Amavita	Pharmacy	NaN	46.512115	6.625829	[[{"label": "display", "lat": 46.51211470542447, "lng": 6.625829}]]	1202	CH	La Harpe	NaN	Schweiz	[La Harpe]	NaN	NaN	4e78983e7d5b90e4420889cc
2	Pharmacie des Bergières	Pharmacy	Avenue Bergières 42	46.530844	6.619640	[[{"label": "display", "lat": 46.530844, "lng": 6.61964}]]	1417	CH	Lausanne	Vaud	Suisse	[Avenue Bergières 42, 1004 Lausanne]	1004	NaN	4f71a3d2e4008ba3d7f7e40
3	Pharmacie Nouvelle	Pharmacy	Rue Centrale 15	46.521084	6.634121	[[{"label": "display", "lat": 46.521084, "lng": 6.634121}]]	136	CH	Lausanne	Vaud	Suisse	[Rue Centrale 15, 1003 Lausanne]	1003	NaN	55e8b0c42498a815d05558490
4	Pharmacie Amavita	Pharmacy	NaN	46.512764	6.655341	[[{"label": "display", "lat": 46.512764, "lng": 6.655341}]]	2006	CH	Peraudetta	NaN	Schweiz	[Peraudetta]	NaN	NaN	50883041e4b0b296d3d27526
5	Pharmacie Pulliérens	Pharmacy	Rue de la Poste 26	46.512580	6.657969	[[{"label": "display", "lat": 46.5125803499109, "lng": 6.657969}]]	2192	CH	Pully	Vaud	Suisse	[Rue de la Poste 26, 1009 Pully]	1009	NaN	4d10f01a50ca10d55338c3d
6	Pharmacie Internationale	Pharmacy	Place St François 6	46.519965	6.633381	[[{"label": "display", "lat": 46.51996483333332, "lng": 6.633381}]]	213	CH	Lausanne	Vaud	Suisse	[Place St François 6, 1002 Lausanne]	1002	NaN	4ca02e907d96dcdbf1ae5d1

Figure 1. Dataframe of 50 pharmacies in Lausanne obtained from FourSquare.

Ideally, data on pharmacies revenue and profitability would be important to inform decisions. Unfortunately, such data are not available and therefore assumption is made that all pharmacies have acceptable revenue and profitability. Therefore, there will be no attempt to optimize – i.e. consolidate – pharmacies in high-density areas. Areas with high-density of pharmacies will be considered as successful neighbourhoods (locations) for benchmarking.

Methods

Machine learning technique Heatmap plugin using Kernel Density Estimation was used to create a density map of pharmacies in Lausanne.

Based on the density map, five neighbourhoods with high density of pharmacies were selected as reference locations. As mentioned in the data section, assuming that all pharmacies are profitable, high-density locations were considered as attractive neighbourhoods for pharmacy business. Based on the same density map, ten neighbourhoods with low density of pharmacies were selected for exploration as candidate-locations for opening a new pharmacy.

Ten candidate-neighbourhoods were compared to five reference-neighbourhoods. The data on 15 selected neighbourhoods will be obtained from FourSquare using explore query. Most frequent venues were determined by analysing the frequencies by neighbourhood. Then the dataframe with top ten most common venues by neighbourhood were created for clustering of 15 neighbourhoods.

Machine learning techniques K-means Clustering was used to cluster neighbourhoods to inform the decision where to open new pharmacy. 15 neighbourhoods were clustered into 4 groups (k -cluster = 4). The analysis with different k -clusters parameter was also performed to evaluate the sensitivity of decision making to number of clusters selected. The results were visualized on the map. Neighbourhoods classified as similar to the reference locations, i.e. in

the same cluster with the highest number of reference locations, were considered as high potential candidate-locations to open a new pharmacy.

Results

Heatmap plugin using Kernel Density Estimation was used to create a density map of 50 pharmacies in Lausanne (Figure 1).

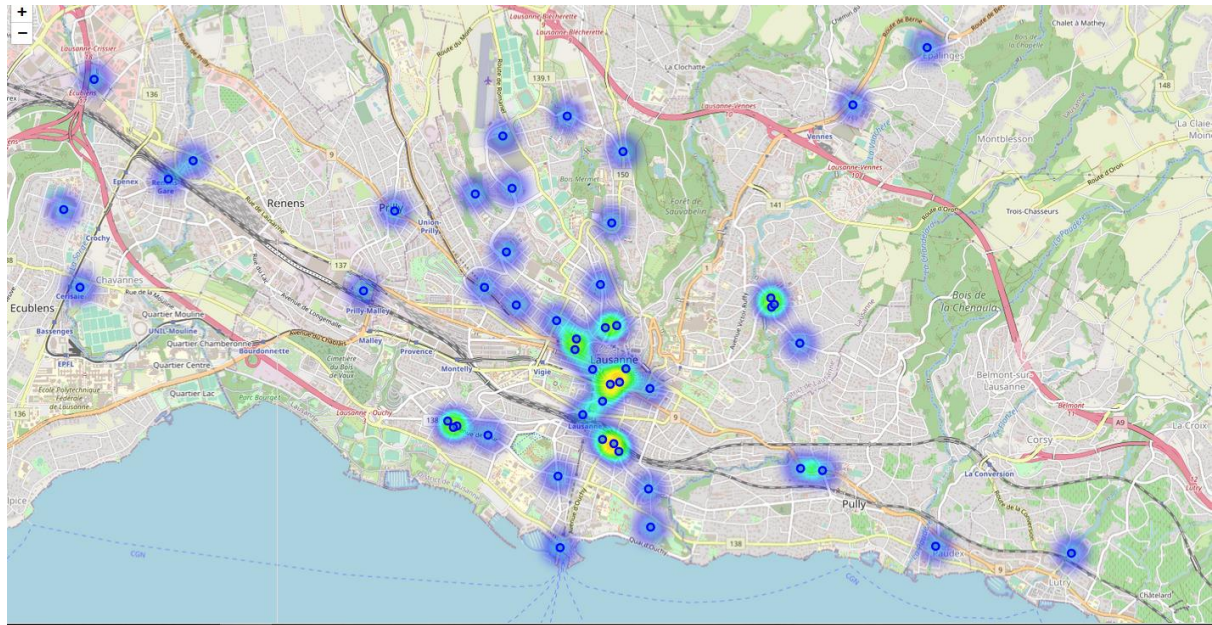


Figure 2. Lausanne pharmacies: density map

The map above allowed to identify five areas with highest density of pharmacies, which were selected as reference locations to create the dataframe of the reference-neighbourhoods.

Out[12]:

	latitude	longitude	area
0	46.523655	6.627958	Pharmacie de la Tour, Lausanne
1	46.520073	6.633325	Pharmacie Internationale, Lausanne
2	46.524637	6.633160	Pharmacie Gamma, Lausanne
3	46.514287	6.633366	Pharmacie 24, Lausanne
4	46.526477	6.652110	Pharmacie de Chailly SA, Lausanne

Figure 3. Dataframe: selected reference-neighbourhoods.

The same density map visualized not only low-density area but also many areas without pharmacies. Therefore 10 residential areas without pharmacies were selected as candidate-neighbourhoods for opening a new pharmacy business. The location of these neighbourhoods were obtained from FourSquare. Reference-neighbourhoods and candidate-neighbourhoods

with their respective location's coordinates were combined into neighbourhood dataframe for further analysis.

	latitude	longitude	Neighborhood
0	46.523655	6.627958	Pharmacie de la Tour, Lausanne
1	46.520073	6.633325	Pharmacie Internationale, Lausanne
2	46.524637	6.633160	Pharmacie Gamma, Lausanne
3	46.514287	6.633366	Pharmacie 24, Lausanne
4	46.526477	6.652110	Pharmacie de Chailly SA, Lausanne
5	46.535834	6.591936	renens-village, Vaud
6	46.512649	6.561130	ecole de saint sulpice, Vaud
7	46.540542	6.602383	Avenue du Château 73, Prilly, Vaud
8	46.540542	6.602383	Avenue du Château 73, Prilly, Vaud
9	46.516299	6.641442	Avenue de Rumine 30, Lausanne, Vaud
10	46.509824	6.655224	Avenue Charles Ferdinand Ramuz 29, Pully, Vaud
11	46.506627	6.652333	Avenue Général-Guisan 24, Pully, Vaud
12	46.520556	6.661260	Avenue de la Rosiaz, Pully, Vaud
13	46.554164	6.634814	Route de Lausanne 33, Le Mont-sur-Lausanne, Vaud
14	46.536118	6.648725	Route de Berne 24, lausanne, Vaud

Figure 3. Dataframe: reference- and candidate-neighbourhoods.

386 venues for the selected neighbourhoods were obtained from FourSquare using explore queries. The analysis of venues by category identified 94 unique categories. Frequency of venues was used to identify most common venues. Data on top 10 most common venues by neighbourhoods was used for clustering analysis.

	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	Avenue Charles Ferdinand Ramuz 29, Pully, Vaud	Swiss Restaurant	Park	Gay Bar	Pizza Place	Middle Eastern Restaurant	Sandwich Place	Italian Restaurant	Sports Club	Ice Cream Shop	Supermarket
1	Avenue Général-Guisan 24, Pully, Vaud	Park	Swiss Restaurant	Middle Eastern Restaurant	Pizza Place	Gas Station	Bus Station	Sandwich Place	Sports Club	Ice Cream Shop	Supermarket
2	Avenue de Rumine 30, Lausanne, Vaud	Bar	Hotel	French Restaurant	Italian Restaurant	Plaza	Supermarket	Park	Middle Eastern Restaurant	Sandwich Place	Bakery
3	Avenue de la Rosiaz, Pully, Vaud	Park	Bus Station	Middle Eastern Restaurant	Sushi Restaurant	General Entertainment	Gas Station	Rental Service	Train Station	Fast Food Restaurant	Supermarket
4	Avenue du Château 73, Prilly, Vaud	Train Station	Grocery Store	Swiss Restaurant	Supermarket	Indian Restaurant	Italian Restaurant	Diner	Restaurant	Bus Stop	Pool
5	Pharmacie 24, Lausanne	Hotel	Italian Restaurant	Bar	French Restaurant	Plaza	Restaurant	Park	Café	Gym	Yoga Studio
6	Pharmacie Gamma, Lausanne	Bar	Italian Restaurant	Hotel	Plaza	French Restaurant	Supermarket	Platform	Art Museum	Breakfast Spot	Department Store
7	Pharmacie Internationale, Lausanne	Bar	French Restaurant	Italian Restaurant	Plaza	Gym	Pizza Place	Japanese Restaurant	Hotel	Restaurant	Burger Joint
8	Pharmacie de Chailly SA, Lausanne	Supermarket	Metro Station	Sushi Restaurant	Hotel	Thai Restaurant	Department Store	Park	Plaza	Cafeteria	Gym / Fitness Center
9	Pharmacie de la Tour, Lausanne	Bar	French Restaurant	Plaza	Japanese Restaurant	Pizza Place	Italian Restaurant	Burger Joint	Café	Coffee Shop	Lounge
10	Route de Berne 24, lausanne, Vaud	Scenic Lookout	Gas Station	Supermarket	Zoo Exhibit	Swiss Restaurant	Park	College Gym	Lake	Plaza	Aquarium
11	Route de Lausanne 33, Le Mont-sur-Lausanne, Vaud	Supermarket	Asian Restaurant	Gas Station	Diner	Falafel Restaurant	Coffee Shop	College Gym	College Lab	Creperie	Cupcake Shop
12	ecole de saint sulpice, Vaud	Café	Beach	Hotel	College Lab	Chocolate Shop	Bar	Swiss Restaurant	Bus Station	French Restaurant	English Restaurant
13	renens-village, Vaud	Supermarket	Gym	Italian Restaurant	Fast Food Restaurant	Pool	Department Store	Bus Station	Shopping Mall	Electronics Store	Brazilian Restaurant

Figure 4. Dataframe: top most common venues by neighbourhood.

K-means Clustering was used to cluster neighbourhoods. The results of clustering are visualized on the map below.

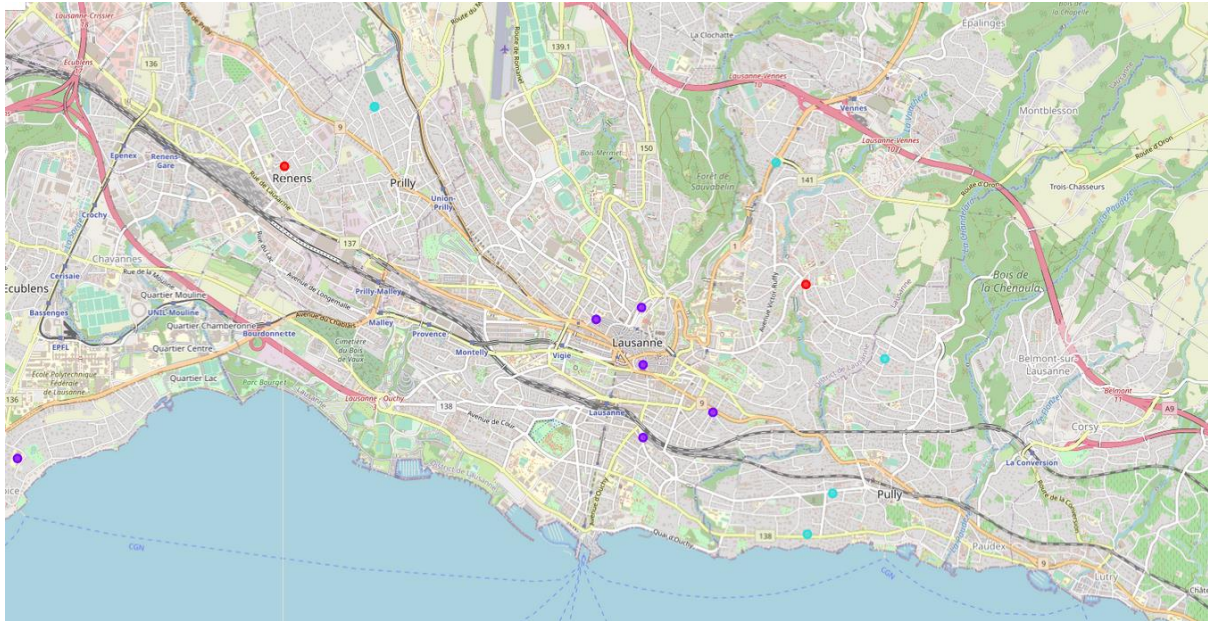


Figure 4. Clustering of neighbourhoods

Based on clustering results, two neighbourhoods - area of Avenue de Rumine 30 and the area of Ecole de Saint Sulpice are similar to reference-neighbourhoods. These two neighbourhoods are in the cluster with the highest number of reference locations and therefore selected as high potential candidate-locations to open a new pharmacy.

Discussion

The pharmacies' density heatmap and analysis of neighbourhoods can provide useful information to inform investors decisions on the location for a new pharmacy business. The visualization provided by density heatmap allows efficient selection of high-density areas, which could be considered either as location-reference for successful business or a candidate-areas for pharmacy consolidation (reduction and merging some pharmacies). The information on pharmacies revenue and profitability would be very important to inform this decision. Data on revenue and profitability could also allow analysis of association between the business performance and venues in the neighbourhood. In the absence on such information, all high-density areas were considered as successful locations for this project.

The exploration and analysis of venues provide useful information to analyse the similarity between neighbourhoods to select those most similar to references (successful locations). The limitation of the approach based on FourSquare search and explore queries is the quality of information that can be obtained from FourSquare for the selected city. Only 50 pharmacies were obtained though this search, which certainly does not reflect the real situation for Lausanne. Repeating search queries using the range of Radius as parameter did not help to improve the quality of data obtained. Therefore, in the absence of another data

source, the information on only 50 pharmacies obtained from FourSquare was used for this project.

K-means Clustering was performed using k-cluster parameter of 4 and 5. The results visualised below lead to the same conclusion on the selection of neighbourhood to open new pharmacy.

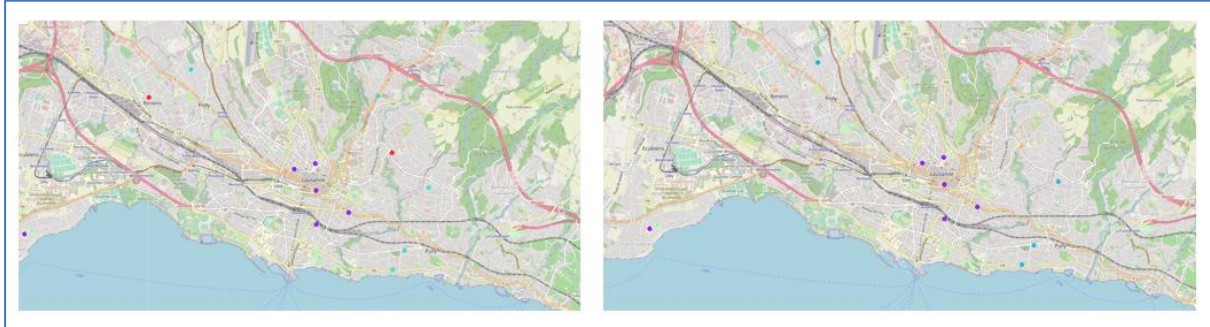


Figure 5. Clustering of neighbourhoods: 4 clusters (left) and 5 clusters (right).

Conclusions

The analysis of the locations using Machine Learning techniques Kernel Density Estimation-based Heatmap plugin and K-means Clustering leveraging data obtained from FourSquare can inform investor's decision on location for a new business. In this project, such analysis allowed to identify high-potential neighbourhoods as potential location to open a new pharmacy business in Lausanne.