

Predicting best zones and districts for setting up Georgian restaurant in Doha, Qatar

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May, 2020

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Introduction

In this project we will investigate possibility to find an optimal location for a restaurant. Specifically, this report will be targeted to stakeholders interested in opening an Georgian restaurant in Doha, Qatar. There are a lot of restaurants in Doha, so we will try to detect locations that are not already crowded with restaurants. We are also particularly interested in areas with no Georgian restaurants around. We would also prefer most populated locations, assuming that first two conditions are met. We will use our data science powers to generate a few most promising neighborhoods based on this criteria. Advantages of each area will then be clearly expressed so that best possible final location can be chosen by stakeholders.

Data

Based on problem definition, factors that will influence our decision are:

- number of existing restaurants in the neighborhood (any type of restaurant)
- number of Georgian restaurants in the neighborhood, if any
- population of neighborhood

We decided to use existing zones and districts in Doha as neighborhoods for this project.

Following data sources will be needed to extract/generate the required information:

- centers of candidate areas will be generated algorithmic and approximate addresses of centers of those areas will be obtained using Wikipedia and OpenStreetMap Nominatim API data
- number of restaurants and their type and location in every neighborhood will be obtained using Foursquare API
- Population of each neighborhood will be obtained from Wikipedia

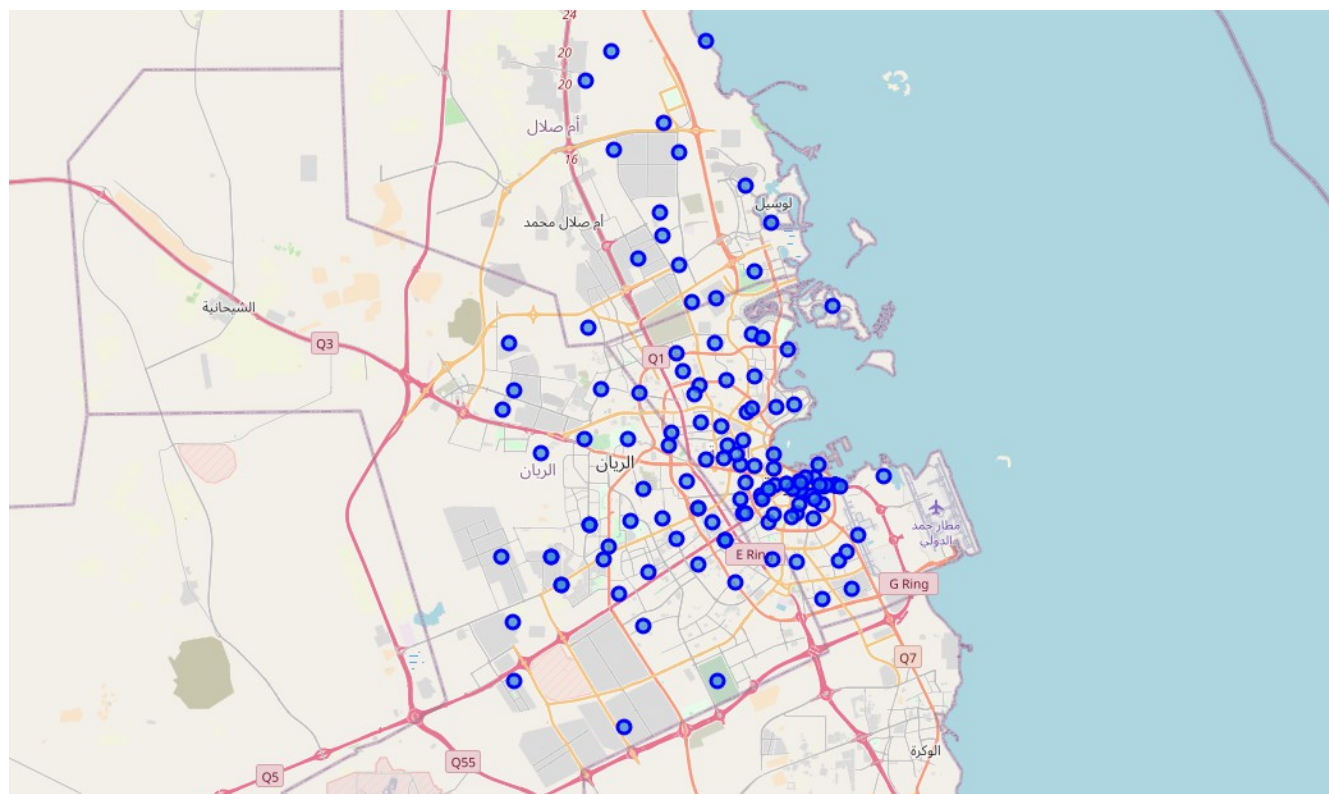
After processing data from Wikipedia en-reached with Nomunatim coordination look like this:

`Out[12]:`

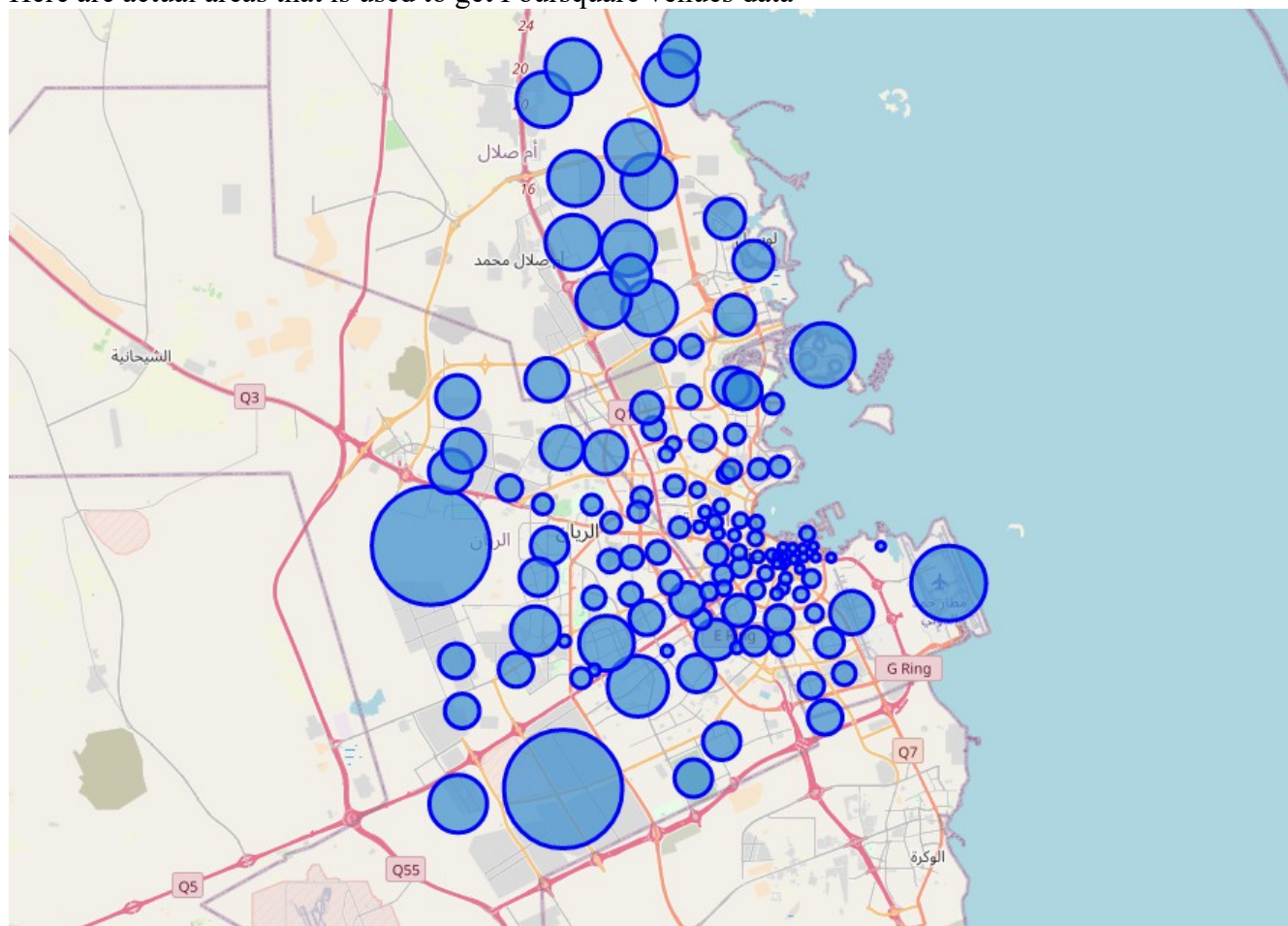
	Zone	District	Area	Population	Latitude	Longitude	P	radius	Neighborhood
0	97	Sawda Natheel	566.700	100	24.56833	51.06833	1	6715.0	Sawda Natheel,z97
1	96	Abu Samra	801.700	984	24.73806	50.89528	1	7987.0	Abu Samra,z96
2	83	Al Karaana	554.300	2614	25.01111	51.04444	1	6642.0	Al Karaana,z83
3	81	Mebaireek	160.500	12483	25.19000	51.38000	1	3574.0	Mebaireek,z81
4	70	Rawdat Al Hamama	19.925	4416.75	25.44611	51.46861	12	1259.0	Rawdat Al Hamama,z70

As you can see we define neighborhood as combination of district and zone.

Here are centers of our neighborhoods



Here are actual areas that is used to get Foursquare venues data



After getting venues data from Foursquare we will get following number of venues per neighborhood

Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Pearl,z66	100	100	100	100	100	100
Al Dafna,z61	73	73	73	73	73	73
Al Aziziya,z55	53	53	53	53	53	53
Al Ebb,z70	49	49	49	49	49	49
Doha International Airport,z49	48	48	48	48	48	48
Fereej Al Soudan,z55	42	42	42	42	42	42
Al Sadd,z38	39	39	39	39	39	39
Doha International Airport,z48	38	38	38	38	38	38
Al Gharrafa,z51	36	36	36	36	36	36
Abu Hamour,z56	35	35	35	35	35	35
Al Qassar,z61	35	35	35	35	35	35
Al Sadd,z39	30	30	30	30	30	30
New Al Rayyan,z53	24	24	24	24	24	24
Al Jasrah,z1	21	21	21	21	21	21
Nuaija,z41	21	21	21	21	21	21
Fereej Bin Mahmoud,z22	19	19	19	19	19	19
Fereej Bin Mahmoud,z23	19	19	19	19	19	19
Hazm Al Markhiya,z67	18	18	18	18	18	18
Ain Khaled,z56	17	17	17	17	17	17
Old Airport,z45	17	17	17	17	17	17
Al Mamoura,z56	17	17	17	17	17	17
Al Khulaifat,z28	14	14	14	14	14	14
Baaya,z54	13	13	13	13	13	13
New Al Mirqab,z39	12	12	12	12	12	12
Muaither,z53	12	12	12	12	12	12

Let's see if any of these are actually **Georgian restaurant**

```
In [35]: Doha_venues_[Doha_venues_['Venue Category']=='Caucasian Restaurant'].count()

Out[35]: Neighborhood      0
          Neighborhood Latitude  0
          Neighborhood Longitude  0
          Venue              0
          Venue Latitude      0
          Venue Longitude     0
          Venue Category      0
          dtype: int64
```

Unexpected result – there are no Georgian restaurants in Doha. This concludes the data gathering phase - we're now ready to use this data for analysis to locate optimal locations for a new Georgian restaurant.

Methodology

In this project we will direct our efforts on detecting areas of Doha that have low restaurant density. In first step we have collected the required data about neighborhoods of Doha and venues within there neighborhoods using Foursquare API

In next and final step we will focus on differences and similarities of these neighborhoods by grouping them into clusters (using k-means clustering) and analyzing each cluster individually. We will present map of all neighborhoods and clusters that they form to identify general zones / district which should be a starting point for final 'street level' exploration and search for optimal venue location by stakeholders.

Here is that approach in details. Firstly we will normalize data set.

Out[37]:

	Neighborhood	Accessories Store	Afghan Restaurant	African Restaurant	Airport	Airport Food Court	Airport Lounge	Airport Service	American Restaurant	Aquarium	...	Tex-Mex Restaurant	Thai Restaurant	Theater	Toy / Game Store	Turkish Restaurant	Vegetarian / Vegan Restaurant	Volleyball Court	Wings Joint	Women's Store	Zoo
0	Abu Hamour,z56	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.0	0.0	0.028571	0.0	0.0	0.0	0.0	0.0
1	Abu Samra,z96	0.0	0.000000	0.0	0.2	0.0	0.0	0.0	0.200000	0.0	...	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
2	Ad Dawhah al Jadidah,z15	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.0	0.0	0.250000	0.0	0.0	0.0	0.0	0.0
3	Ain Khaled,z56	0.0	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	...	0.0	0.0	0.0	0.0	0.058824	0.0	0.0	0.0	0.0	0.0
4	Al Aziziya,z55	0.0	0.018868	0.0	0.0	0.0	0.0	0.0	0.037736	0.0	...	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	0.0	0.0

5 rows x 217 columns

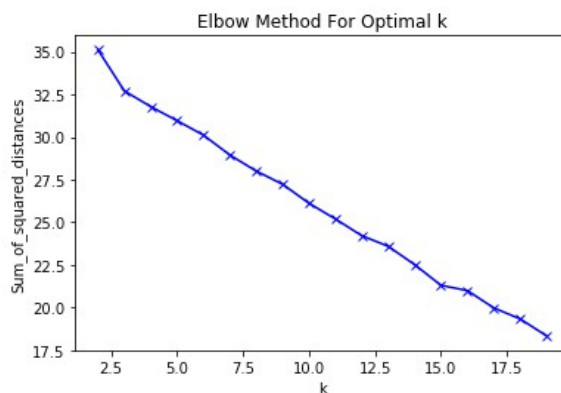
Then we get top 4 venues for each neighborhood

Out[38]:

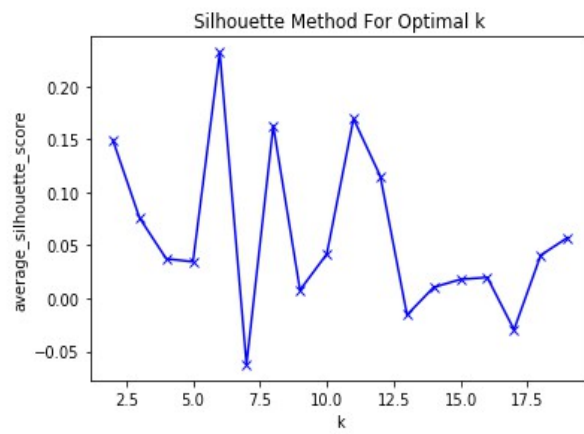
	Neighborhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
0	Abu Hamour,z56	Café	Coffee Shop	Fast Food Restaurant	Middle Eastern Restaurant
1	Abu Samra,z96	Border Crossing	Airport	Beach	American Restaurant
2	Ad Dawhah al Jadidah,z15	Turkish Restaurant	Hotel	Bakery	Café
3	Ain Khaled,z56	Coffee Shop	Asian Restaurant	Indian Chinese Restaurant	Chinese Restaurant
4	Al Aziziya,z55	Café	Asian Restaurant	Coffee Shop	Cafeteria

On normalized data set we will apply k-means clustering method, but first we will find number of clusters that will be used. Elbow method will be used here to decide number of clusters. If it will not be enough to decide we will also use Average silhouette score method.

Here is elbow method:



It is not very decisive. Let's see average silhouette score method:



Maximum score is for 6 clusters. We will use k-means method with 6 clusters.

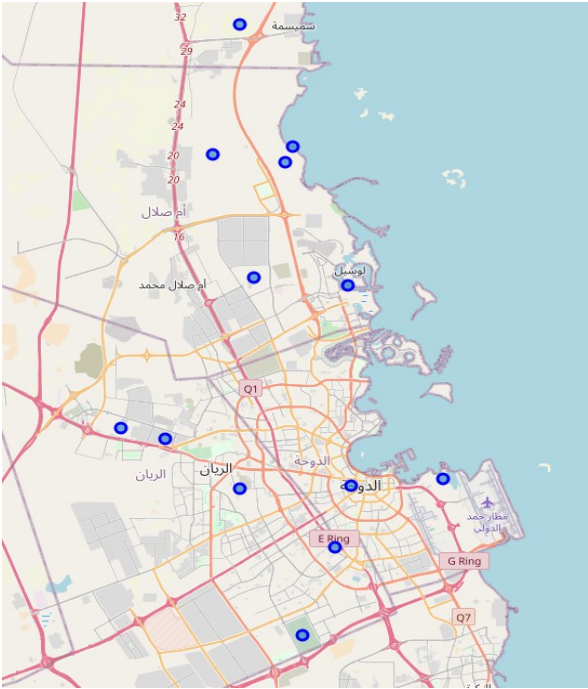
Results and discussion

First let see neighborhoods with no venues at all, we will note them as 16th cluster:

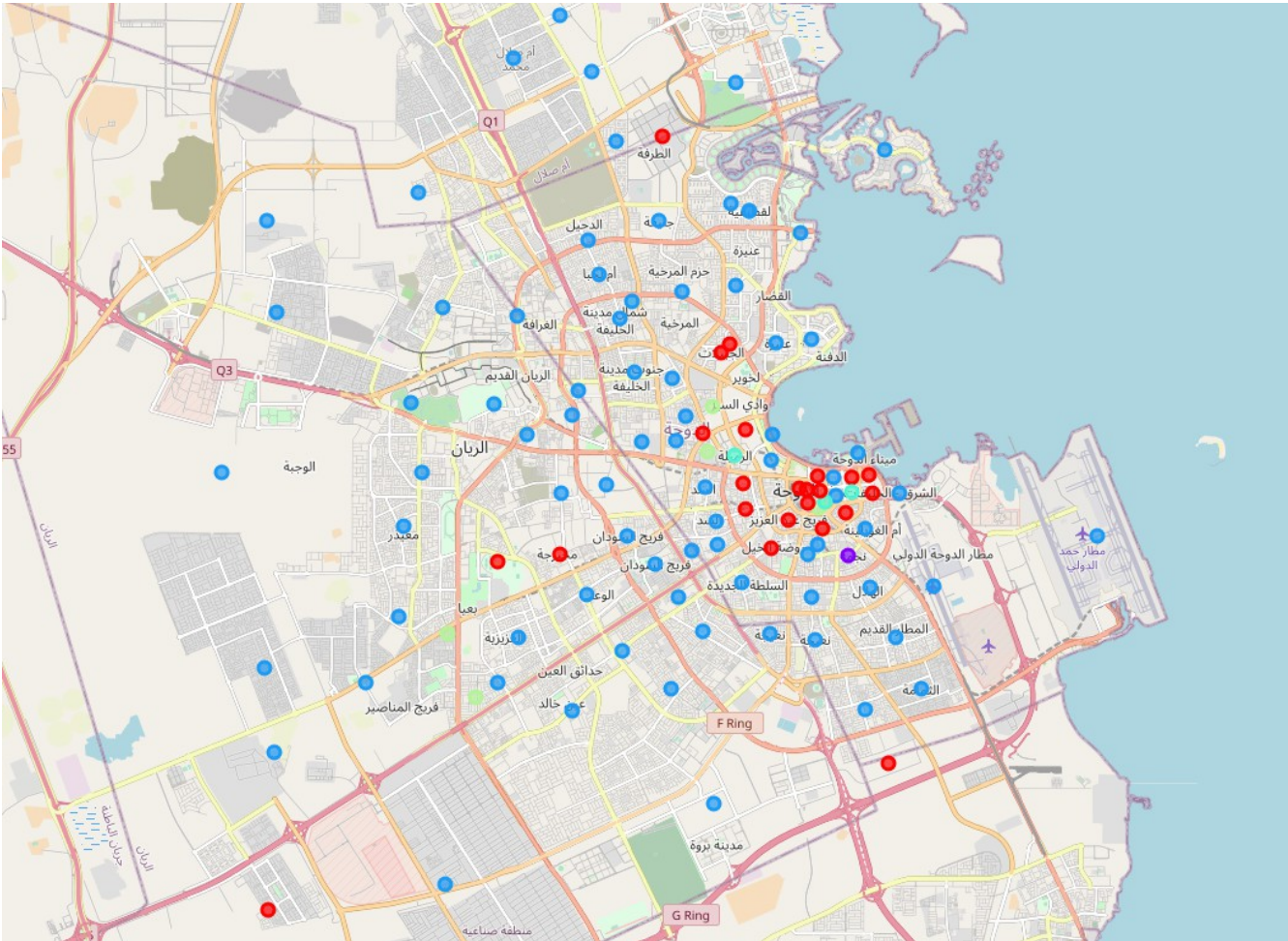
Out[51]:

	Zone	District	Area	Population	Latitude	Longitude	P	radius	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
7	70	Al Kheesa	19.925000	4416.75	25.417500	51.458890	12	1259.0	Al Kheesa,z70	NaN	NaN	NaN	NaN	NaN
11	70	Wadi Lusail	19.925000	4416.75	25.495510	51.432371	12	1259.0	Wadi Lusail,z70	NaN	NaN	NaN	NaN	NaN
12	70	Lusail	19.925000	4416.75	25.490588	51.478883	12	1259.0	Lusail,z70	NaN	NaN	NaN	NaN	NaN
13	70	Umm Qarn	19.925000	4416.75	25.577780	51.450000	12	1259.0	Umm Qarn,z70	NaN	NaN	NaN	NaN	NaN
16	69	Jabal Thuaileb	10.220000	267.6	25.412220	51.518330	5	902.0	Jabal Thuaileb,z69	NaN	NaN	NaN	NaN	NaN
19	69	Lusail	10.220000	267.6	25.500000	51.483000	5	902.0	Lusail,z69	NaN	NaN	NaN	NaN	NaN
36	56	Mesaimeer	8.728571	18418.3	25.190000	51.489720	7	833.0	Mesaimeer,z56	NaN	NaN	NaN	NaN	NaN
42	56	New Fereej Al Khulaifat	8.728571	18418.3	25.246088	51.510380	7	200.0	New Fereej Al Khulaifat,z56	NaN	NaN	NaN	NaN	NaN
56	54	Muraikh	3.016667	4098.83	25.283330	51.450000	6	490.0	Muraikh,z54	NaN	NaN	NaN	NaN	NaN
69	51	Al Seej	11.557143	8003.86	25.321845	51.374191	7	959.0	Al Seej,z51	NaN	NaN	NaN	NaN	NaN
70	51	Bani Hajer	11.557143	8003.86	25.314677	51.402261	7	600.0	Bani Hajer,z51	NaN	NaN	NaN	NaN	NaN
100	28	Ras Abu Aboud	0.450000	865.5	25.289700	51.578900	2	189.0	Ras Abu Aboud,z28	NaN	NaN	NaN	NaN	NaN
119	13	Mushayrib	0.700000	18278	25.285114	51.520455	1	236.0	Mushayrib,z13	NaN	NaN	NaN	NaN	NaN

Let visualize them:



Let's see rest of clusters:



Cluster 1:

```
In [40]: Doha_merged.loc[Doha_merged['Cluster Labels'] == 0, Doha_merged.columns[[1] + [3] + list(range(6, Doha_merged.shape[1]))]]
```

Out[40]:

	District	Population	P	radius	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
48	Fereej Al Murra	28367.5	10	410.0	Fereej Al Murra,z55	0	Department Store	Asian Restaurant	Cafeteria	Farm
49	Fereej Al Manaseer	28367.5	10	250.0	Fereej Al Manaseer,z55	0	Athletics & Sports	Zoo	Dessert Shop	Farm
89	Hamad Medical City	8707	3	258.0	Hamad Medical City,z37	0	Asian Restaurant	Athletics & Sports	Pool Hall	Cafeteria
110	Wadi Al Sail	240	1	322.0	Wadi Al Sail,z20	0	Pharmacy	Asian Restaurant	Boutique	Cafeteria
125	Fereej Al Asmakh	695.333	3	73.0	Fereej Al Asmakh,z5	0	Asian Restaurant	Indonesian Restaurant	Zoo	Farm

Cluster 2:

```
In [41]: Doha_merged.loc[Doha_merged['Cluster Labels'] == 1, Doha_merged.columns[[1] + [3] + list(range(6, Doha_merged.shape[1]))]]
```

Out[41]:

	District	Population	P	radius	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
4	Rawdat Al Hamama	4416.75	12	1259.0	Rawdat Al Hamama,z70	1	Diner	Zoo	Clothing Store	Farm

Cluster 3:

```
In [42]: Doha_merged.loc[Doha_merged['Cluster Labels'] == 2, Doha_merged.columns[[1] + [3] + list(range(6, Doha_merged.shape[1]))]]
```

Out[42]:

	District	Population	P	radius	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
3	Mebareek	12483	1	1350.0	Mebareek,z81	2	Market	Restaurant	Department Store	Falafel Restaurant
23	Al Tarfa	1840.33	3	507.0	Al Tarfa,z68	2	Coffee Shop	Food Court	Zoo	Dessert Shop
30	Lejbailat	4151	1	334.0	Lejbailat,z64	2	Fast Food Restaurant	Coffee Shop	Hotel	Palace
54	Mehairja	4098.83	6	490.0	Mehairja,z54	2	Hotel	Park	Zoo	Department Store
55	Baaya	4098.83	6	490.0	Baaya,z54	2	Athletics & Sports	Hotel	Gym / Fitness Center	Turkish Restaurant
74	Zone 50	1137	1	778.0	Zone 50,z50	2	Gym / Fitness Center	Restaurant	Zoo	Department Store
95	Al Markhiya	6242	1	464.0	Al Markhiya,z33	2	Fast Food Restaurant	Flower Shop	Hotel	Café
106	Rawdat Al Khail	18200	1	368.0	Rawdat Al Khail,z24	2	Indian Restaurant	Gym	Hotel	Shop & Service
107	Fereej Bin Mahmoud	17086	1	400.0	Fereej Bin Mahmoud,z23	2	Hotel	Thai Restaurant	Korean Restaurant	Food & Drink Shop
108	Fereej Bin Mahmoud	11241	1	300.0	Fereej Bin Mahmoud,z22	2	Hotel	Fast Food Restaurant	Korean Restaurant	Gym / Fitness Center
112	Al Mirqab	346	2	155.0	Al Mirqab,z18	2	Hotel	Furniture / Home Store	Motel	Market
113	As Salatah	346	2	155.0	As Salatah,z18	2	Hotel	Restaurant	Middle Eastern Restaurant	Café
114	Old Al Hitmi	3013	2	126.0	Old Al Hitmi,z17	2	Turkish Restaurant	Hotel	Middle Eastern Restaurant	Sandwich Place
116	Old Al Ghanim	16334	1	178.0	Old Al Ghanim,z16	2	Hotel	Restaurant	Zoo	Department Store
117	Ad Dawhah al Jadidah	15920	1	199.0	Ad Dawhah al Jadidah,z15	2	Turkish Restaurant	Hotel	Bakery	Café
118	Fereej Abdel Aziz	15706	1	300.0	Fereej Abdel Aziz,z14	2	Hotel	Pakistani Restaurant	Shawarma Place	Furniture / Home Store
121	Rumailah	63	1	282.0	Rumailah,z11	2	Park	Middle Eastern Restaurant	Zoo	Department Store
122	Wadi Al Sail	8	1	282.0	Wadi Al Sail,z10	2	Coffee Shop	Pizza Place	Residential Building (Apartment / Condo)	Restaurant
127	Al Najada	695.333	3	73.0	Al Najada,z5	2	Hotel	Middle Eastern Restaurant	Zoo	Department Store
128	Mushayrib	9791	1	155.0	Mushayrib,z4	2	Asian Restaurant	Hotel	Bar	BBQ Joint
129	Mushayrib	2443	2	250.0	Mushayrib,z3	2	Coffee Shop	Hotel	Plaza	Currency Exchange
130	Fereej Mohamed Bin Jasim	2443	2	100.0	Fereej Mohamed Bin Jasim,z3	2	Coffee Shop	Hotel	Restaurant	Zoo
132	Al Jasrah	240	1	178.0	Al Jasrah,z1	2	Café	Coffee Shop	Middle Eastern Restaurant	Restaurant

Cluster 4

```
In [43]: Doha_merged.loc[Doha_merged['Cluster Labels'] == 3, Doha_merged.columns[[1] + [3] + list(range(6, Doha_merged.shape[1]))]]
```

Out[43]:

	District	Population	P	radius	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
103	Najma	28228	1	296.0	Najma,z26	3	Bed & Breakfast	Fast Food Restaurant	Farm	Falafel Restaurant

Cluster 5

```
In [44]: Doha_merged.loc[Doha_merged['Cluster Labels'] == 4, Doha_merged.columns[[1] + [3] + list(range(6, Doha_merged.shape[1]))]]
```

Out[44]:

	District	Population	P	radius	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
0	Sawda Natheel	100	1	6715.0	Sawda Natheel,z97	4	Campground		Zoo	Department Store
1	Abu Samra	984	1	7987.0	Abu Samra,z96	4	Border Crossing		Airport	Beach
2	Al Karaana	2614	1	6642.0	Al Karaana,z83	4	Airport Service		Lake	Airport
5	Leabaib	4416.75	12	1259.0	Leabaib,z70	4	Coffee Shop	Grocery Store	Athletics & Sports	Intersection
6	Jeryan Jenaihat	4416.75	12	1259.0	Jeryan Jenaihat,z70	4	Beach	Construction & Landscaping	Fast Food Restaurant	Zoo
8	Al Ebb	4416.75	12	1259.0	Al Ebb,z70	4	Coffee Shop	Ice Cream Shop	Clothing Store	Italian Restaurant
9	Al Sakhama	4416.75	12	1259.0	Al Sakhama,z70	4	Farm	Soccer Stadium	Boarding House	Dessert Shop
10	Al Masrouhiya	4416.75	12	1259.0	Al Masrouhiya,z70	4	Construction & Landscaping	Campground	Art Gallery	Zoo
14	Al Daayen	4416.75	12	1259.0	Al Daayen,z70	4	Beach	Turkish Restaurant	Cafeteria	Zoo
15	Wadi Al Wasaah	4416.75	12	1259.0	Wadi Al Wasaah,z70	4	Farm	Boat or Ferry	Cafeteria	Burger Joint
17	Wadi Al Banat	267.6	5	902.0	Wadi Al Banat,z69	4	Shopping Mall		Zoo	Farmers Market
18	Al Kharayej	267.6	5	902.0	Al Kharayej,z69	4	Pizza Place		Zoo	Department Store
20	Al Egla	267.6	5	902.0	Al Egla,z69	4	Lounge	Cricket Ground		Rugby Pitch
21	Jelaiah	1840.33	3	507.0	Jelaiah,z68	4	Cable Car		Zoo	Department Store
22	Jeryan Nejaima	1840.33	3	507.0	Jeryan Nejaima,z68	4	Fast Food Restaurant		Market	Castle
24	Hazm Al Markhiya	8967	1	578.0	Hazm Al Markhiya,z67	4	Café	Coffee Shop	Restaurant	Perfume Shop
25	Onaiza	7341.33	3	832.0	Onaiza,z66	4	Supermarket	Grocery Store	Sandwich Place	Fruit & Vegetable Store
26	Leqtaifiya	7341.33	3	832.0	Leqtaifiya,z66	4	Sandwich Place	Italian Restaurant	Supermarket	Grocery Store
27	Al Qassar	7341.33	3	832.0	Al Qassar,z66	4	Supermarket	Grocery Store	Sandwich Place	Fruit & Vegetable Store
28	Pearl	27000	1	1441.0	Pearl,z66	4	Café	Coffee Shop	Middle Eastern Restaurant	Italian Restaurant
29	Onaiza	7875	1	409.0	Onaiza,z65	4	Supermarket	Fast Food Restaurant	Pizza Place	Sandwich Place
31	Onaiza	7562	1	399.0	Onaiza,z63	4	Coffee Shop	Construction & Landscaping	Café	Middle Eastern Restaurant
32	Al Dafna	2011	2	399.0	Al Dafna,z61	4	Coffee Shop	Café	Sporting Goods Shop	Fast Food Restaurant
33	Al Qassar	2011	2	399.0	Al Qassar,z61	4	Restaurant	Beach	Seafood Restaurant	Hotel Bar
34	Zone 58	4692	1	252.0	Zone 58,z58	4	Grocery Store	Flea Market	Flower Shop	Restaurant

35	Industrial Area	364710	1	2750.0	Industrial Area,z57	4	Auto Workshop	Fast Food Restaurant	Flea Market	Currency Exchange
37	Abu Hamour	18418.3	7	833.0	Abu Hamour,z56	4	Café	Coffee Shop	Fast Food Restaurant	Middle Eastern Restaurant
38	Al Mamoura	18418.3	7	920.0	Al Mamoura,z56	4	Shopping Mall	Ice Cream Shop	Supermarket	Pharmacy
39	Bu Samra	18418.3	7	833.0	Bu Samra,z56	4	Candy Store	Mobile Phone Shop	Zoo	Dessert Shop
40	Ain Khaled	18418.3	7	1400.0	Ain Khaled,z56	4	Coffee Shop	Asian Restaurant	Indian Chinese Restaurant	Chinese Restaurant
...
77	Al Thumama	12815	1	512.0	Al Thumama,z47	4	Market	Coffee Shop	Fast Food Restaurant	Convenience Store
78	Al Thumama	8552	1	543.0	Al Thumama,z46	4	Pharmacy	Convenience Store	Restaurant	Cafeteria
79	Old Airport	48525	1	612.0	Old Airport,z45	4	Café	Asian Restaurant	Pharmacy	Rental Car Location
80	Nuaija	13765	1	505.0	Nuaija,z44	4	Department Store	Gym / Fitness Center	Soccer Field	Grocery Store
81	Nuaija	14871	1	618.0	Nuaija,z43	4	Movie Theater	Spa	Convenience Store	Candy Store
82	Al Hilal	11671	1	378.0	Al Hilal,z42	4	Department Store	Falafel Restaurant	Jewelry Store	Fast Food Restaurant
83	Nuaija	4743	1	630.0	Nuaija,z41	4	Café	Sandwich Place	Indian Restaurant	Baseball Field
84	New Salatah	16086	1	700.0	New Salatah,z40	4	Gym / Fitness Center	Plaza	Mediterranean Restaurant	Juice Bar
85	Al Sadd	7951	3	400.0	Al Sadd,z39	4	Middle Eastern Restaurant	Fast Food Restaurant	Coffee Shop	Italian Restaurant
86	Fereej Al Nasr	7951	3	356.0	Fereej Al Nasr,z39	4	Turkish Restaurant	Asian Restaurant	Shopping Mall	Supermarket
87	New Al Mirqab	7951	3	268.0	New Al Mirqab,z39	4	Middle Eastern Restaurant	Movie Theater	Coffee Shop	French Restaurant
88	Al Sadd	17820	1	528.0	Al Sadd,z38	4	Café	Hotel	Restaurant	Asian Restaurant
90	Fereej Bin Omran	8707	3	258.0	Fereej Bin Omran,z37	4	African Restaurant	Breakfast Spot	Indian Restaurant	Zoo
91	New Al Hitmi	8707	3	258.0	New Al Hitmi,z37	4	Park	Garden	Zoo	Department Store
92	Al Messila	6803	1	409.0	Al Messila,z36	4	Gym / Fitness Center	Pizza Place	Sandwich Place	Rental Car Location
93	Fereej Kulaib	6507	1	296.0	Fereej Kulaib,z35	4	Convenience Store	Grocery Store	Ice Cream Shop	Café
94	Madinat Khalifa South	38247	1	455.0	Madinat Khalifa South,z34	4	Cafeteria	Persian Restaurant	American Restaurant	Restaurant
96	Dahl Al Hamam	6182	2	309.0	Dahl Al Hamam,z32	4	Gym / Fitness Center	Park	Medical Center	Supermarket
97	Madinat Khalifa North	6182	2	309.0	Madinat Khalifa North,z32	4	Bookstore	Grocery Store	American Restaurant	Farmers Market
98	Umm Lekhba	11897	1	497.0	Umm Lekhba,z31	4	Health & Beauty Service	Dessert Shop	Supermarket	Farm
99	Duhail	7705	1	736.0	Duhail,z30	4	Pharmacy	Grocery Store	French Restaurant	Chocolate Shop
101	Al Khulaifat	865.5	2	189.0	Al Khulaifat,z28	4	Café	Middle Eastern Restaurant	Bus Station	Bar
102	Umm Ghuwailina	33262	1	334.0	Umm Ghuwailina,z27	4	Department Store	Gym	Italian Restaurant	Hong Kong Restaurant
102	Umm Ghuwailina	33262	1	334.0	Umm Ghuwailina,z27	4	Department Store	Gym	Italian Restaurant	Hong Kong Restaurant
104	Fereej Bin Durham	18541	2	244.0	Fereej Bin Durham,z25	4	Filipino Restaurant	Pakistani Restaurant	Beach	Department Store
105	Al Mansoura	18541	2	244.0	Al Mansoura,z25	4	Fast Food Restaurant	Indian Restaurant	Department Store	Grocery Store
111	Doha Port	6	1	282.0	Doha Port,z19	4	Park	History Museum	Pier	Art Gallery
120	Al Bidda	1067	1	282.0	Al Bidda,z12	4	Park	Metro Station	Tennis Stadium	Zoo
123	Al Souq	297	1	155.0	Al Souq,z7	4	Asian Restaurant	Flea Market	Grocery Store	Miscellaneous Shop
124	Old Al Ghanim	1124	1	155.0	Old Al Ghanim,z6	4	Jewelry Store	Hotel	Italian Restaurant	Bakery
131	Al Bidda	35	1	282.0	Al Bidda,z2	4	Historic Site	Bus Stop	Intersection	Comfort Food Restaurant

87 rows x 10 columns

Cluster 6

```
In [46]: Doha_merged.loc[Doha_merged['Cluster Labels'] == 5, Doha_merged.columns[[1] + [3] + list(range(6, Doha_merged.shape[1]))]]
```

Out[46]:

	District	Population	P	radius	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
109	Rumeilah	1590	1	252.0	Rumeilah,z21	5	Café	Zoo	Department Store	Falafel Restaurant
115	Al Rufaa	3013	2	126.0	Al Rufaa,z17	5	Café	Zoo	Department Store	Falafel Restaurant
126	Barahat Al Jufairi	695.333	3	73.0	Barahat Al Jufairi,z5	5	Café	Zoo	Department Store	Falafel Restaurant

Our analysis shows that even though there are plenty of venues in Doha there are still a lot of areas that could be used to open new **Georgian restaurant**.

- Starting with neighborhoods with no venues: We could see that there is big opportunity in Zone 70 which is constantly developing and have growing local population. Also we can see that Mushayrib in Zone 13 which is located in downtown Doha would be a great opportunity due to possible high tourist traffic
- Cluster 1 shows good potential as it has good volume of population on Zone 55
- Cluster 3 would be a good opportunity result as it has big local population as well as hotels as most common venue (indicating a lot of tourists). Note that Mushayrib districts are part of this cluster.

- Cluster 4 would be a great opportunity. There are 28 thousand population with almost no restaurants. I would recommend extra analysis on income before taking decision

Summarizing above data I would recommend **Mushayrib** district in downtown Doha as a place to be considered to open **Georgian restaurant**

Conclusion

Purpose of this project was to identify Doha districts with low number of restaurants in order to help stakeholders in narrowing down the search for optimal location for a new Georgian restaurant.

By using k-means cluster algorithm Doha districts were separated into nine different clusters based on venues available through Foursquare API. Presence of 7th cluster (districts with no venues) shows that there might be not enough data in Foursquare API for Doha in particularly and final decision on optimal restaurant location should be made by stakeholders based on specific characteristics of neighborhoods and locations in every recommended zone, taking into consideration additional factors like housing pricing, income, pedestrian density, number of tourists, hotel occupancy, schools availability, traffic density, social and economic dynamics of every districts, etc.