The Battle of Neighbourhoods in Benin

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1   Introduction

Benin formerly Dahomey, is a francophone country in West Africa. The neighbouring countries to Benin are Togo to the west, Nigeria to the east and Burkina Faso and Niger to the north. In Benin, majority of people lives in the southern part while from the centre to the northern part of the country we have very large surface of land used for farming with few lands used for shopping mall or park or business centres. We explain such situation by the concentration of administrative and economics activities in the southern part of the country. In fact, the capital of Benin is Porto-Novo (situated in the south, department of Oueme), the seat of government is in Cotonou (situated in the south, department of Littoral). Parakou (situated in the north, department of Borgou) added to Cotonou and Porto-Novo are three cities with particular status for their density in administrative and economics activities.

2   Business Problem

For many foreigners investing in Benin as well as citizens it is more common to settle a business in the south and make its flourish by the power of your marketing strategies. However, this could easily turn into a nightmare of endless financial investment due to the very fierce competition between small and big companies or newly established growing companies and old well-established companies. As mentioned earlier, the northern part of the country really abounds of free land that are ready to be used for business establishment and a population badly in need of that. However, entrepreneurs are still sceptic to establish themselves and develop good business activities. In this study we would like to draw again to the attention of Businesses and foreign investors the real existence of an empty vacuum that needs to be filled for good business profit and development of the country at large in order to re-equilibrate this distribution of business activities all over the country.

3   Data Description

To approach this problem, we will use the following data as follow:

- We found the information about the departments and communes of Benin on Wikipedia: We scrape that information to create our data frame of Department, Borough and Region.
- We found sample of dataset about the regions and their neighbourhoods in Benin at the webpage GeoPostcodes: We use this information to create a

geocoder data frame of department, region with their neighbourhood and the information about their latitude and longitude.

- We used Foursquare API to collect the information about the venues in two selected regions: We will select one region in the south and another in the north of the country. These selected regions will be subjected to some analysis to identify the most common venues in these parts of the country.

4 Methodology

The objective of the analysis is to show how distributed are the infrastructures in some specific's neighbourhoods of region in Benin country. Here we decide to focus our analysis on one chosen region and its neighbourhoods in the southern and northern part. In order to achieve this goal, we first scraped information about the twelve departments of Benin and their positions on the map. We found this information on a Wikipedia page accessible from this link https://en.wikipedia.org/wiki/Benin. The scraped and cleaned table look as follow.

	Department	Borough	Region
0	Alibori	Kandi	North East
1	Atakora	Natitingou	North West
2	Atlantique	Allada	South Centre
3	Borgou	Parakou	North East
4	Collines	Dassa-Zoumé	North Centre
5	Kouffo	Aplahoué	South West
6	Donga	Djougou	North West
7	Littoral	Cotonou	South Centre
8	Mono	Lokossa	South West
9	Ouémé	Porto-Novo	South East
10	Plateau	Pobè	South East
11	Zou	Abomey	North Centre

The cleaning process mainly consisted of dropping non relevant columns editing the headings and formatting the data frame for our purpose. It is good to highlight here that the concept of Borough in Benin setting is equivalent to region.

The next step to show the distribution of the infrastructures is to list the region and their neighbourhoods with their geographic position on a world map. We downloaded this information in a csv format file from the sample dataset available at https://www.geopostcodes.com/Benin. It also important here to mention that this limited our scope of research since we couldn't afford to purchase the whole information available on the web page. So, with access to the full dataset we could reach more interesting result. Below the processed information obtained from the geopostcodes webpage.

	Department	Region	Neighborhood	Latitude	Longitude
0	Alibori	Banikoara	Banikoara	11.293970	2.439285
1	Alibori	Banikoara	Founougo	11.465990	2.539781
2	Alibori	Banikoara	Gomparou	11.328576	2.471542
3	Alibori	Banikoara	Goumori	11.178435	2.299982
4	Alibori	Banikoara	Kokey	11.183333	2.283333
5	Alibori	Banikoara	Kokiborou	11.202332	2.320930
6	Alibori	Banikoara	Ounet	11.227149	2.404817
7	Alibori	Banikoara	Sompérékou	11.322743	2.491331
8	Alibori	Banikoara	Soroko	11.327791	2.466952
9	Alibori	Banikoara	Toura	11.243611	2.383056
10	Alibori	Gogounou	Bagou	10.812038	2.724489
11	Alibori	Gogounou	Gougounou	10.833333	2.833333
12	Alibori	Gogounou	Gounarou	10.870144	2.846491
13	Alibori	Gogounou	Ouara	10.866667	2.850000
14	Alibori	Gogounou	Sori	10.718550	2.784205
15	Alibori	Gogounou	Zoungou-Pantrossi	10.735278	2.971111
16	Alibori	Kandi	Angaradébou	11.323293	3.041346

As with the previous data frame, the processing of information consisted of dropping and formatting heading of the data frame.

We now choose the two region we want to explore in our study: Banikoara and Abomey-Calavi. The choice of the two regions has been conditioned by their geographical position and also the ability to be a centre of probable business activities. In fact, Abomey-Calavi (southern part of Benin) is a new growing region inhabited by many citizens and mostly students whereas Banikoara (northern part Benin) is known to be one of the hearts of Cotton activities, an important sector which accounts for 40% of the GDP and roughly 80% of official export receipts. Below an illustration of the region geographical positions of the selected regions alongside with their neighbourhoods.

After selecting the concerned region, we then analyse each neighbourhood using foursquare API and cluster them using the K-means algorithm. Since foursquare API helps to provide the category type of venues in a neighbourhood, we use this information to calculate the frequency of venues in a neighbourhood of the given regions and then identify the most common venues. This result has then been used to cluster the neighbourhood respectively by region and used in deciding whether or not a region is made of common infrastructures such as shopping mall, Business service, health and beauty service, motorcycle shop etc.

To query the information about the venues in a neighbourhood of a region we set the radius to 50000. This value was the only one which allowed us to obtain very consistent result although it is not accurate due to the interference of radius with another neighbourhood.

To cluster the neighbourhood, we used k =2 for Banikoara regions and k=2 for Abomey-Calvai regions. The choice of K has been done after running the algorithm

for different k and eyeballing the results. We have chosen this over the elbow method since the dataset is not big.

5   Results

When we query the neighbourhood via the foursquare API for each region, we obtain respectively 4 venues for Banikoara and 37 for Abomey-Calavi. **Banikoara:**

	name	categories	lat	lng
0	Marché Central De Banikoara	Market	11.295302	2.430920
1	Mercearia Costa e Silva	Food & Drink Shop	11.048706	2.393841
2	Бирина	Food & Drink Shop	11.616608	2.456364
3	Dikmen Caddesi	Plaza	11.362971	2.082923

.

Abomey-Calavi:

	name	categories	lat	lng
0	Eldorado Beach Club	Beach	6.357396	2.463691
1	Code Bar	Lounge	6.351882	2.386449
2	La Roche	Hardware Store	6.362236	2.446222
3	L'Impala	Restaurant	6.353055	2.419738
4	Bangkok Terrasse	Thai Restaurant	6.353996	2.417403
5	Mojito	Music Venue	6.354585	2.436484
6	Ci Gusta	Ice Cream Shop	6.355329	2.417331
7	La Galette à Sucre	Bakery	6.353679	2.397257
8	Erevan	Shopping Mall	6.349273	2.386542
9	Festival Des Glaces	Dessert Shop	6.365025	2.431271
10	Best Western Plus	Resort	6.353737	2.388297
11	Le Livingstone	Pizza Place	6.356746	2.394109
12	Pk 7 Zone Des Ambassades	Plaza	6.366147	2.491329
13	Hotel Du Lac	Hotel Bar	6.358720	2.444861
14	Teranga	Middle Eastern Restaurant	6.356824	2.391105
15	Centre commercial & Hypermarché EREVAN	Shopping Mall	6.349928	2.387082

Now that we have an idea of venues in the regions of Banikoara and AbomeyCalavi our next analysis was to look for the neighbourhoods in these regions and then group the neighbourhoods by venues. In other words, in each neighbourhood add up the number of time a given venue appeared. We later then compute the frequency of appearance of a venue in each neighbourhood. **Banikoara:**

	Neighborhood	Botanical Garden	Breakfast Spot	Bus Stop	Café	Food & Drink Shop	Market	Plaza	Seafood Restaurant	Steakhouse
26	Kokiborou	0	0	0	0	0	0	1	0	0
39	Sompérékou	0	0	0	0	1	0	0	0	0
5	Founougo	0	0	0	0	0	1	0	0	0
43	Soroko	0	0	0	0	1	0	0	0	0
45	Soroko	0	0	1	0	0	0	0	0	0
17	Goumori	0	1	0	0	0	0	0	0	0
21	Kokey	0	0	0	0	0	0	0	0	1
48	Toura	0	0	0	0	0	0	1	0	0
19	Kokey	0	0	0	0	0	1	0	0	0
34	Ounet	0	0	0	0	1	0	0	0	0

.

Abomey-Calavi:

	Neighborhood	African Restaurant	Airport Lounge	Bakery	Beach	Dessert Shop	Fast Food Restaurant	Food	Food Court	French Restaurant	Hardware Store	Hotel	Hotel Bar	Ice Cream Shop	Japanese Restaurant	Lounge
148	Hévié	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
318	Zinvié	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
6	Abomey-Calavi	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
205	Kpanroun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
95	Glo-Djigbé	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
171	Hévié	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
125	Godomey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
327	Zinvié	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
74	Glo-Djigbé	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
112	Godomey	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

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Below the computation of frequency of occurrences of venues in each neighbourhoods of the given regions. **Banikoara:**

```
----Banikoara----
              venue  freq
0  Food & Drink Shop  0.50
1            Market   0.25
2             Plaza   0.25
3   Botanical Garden  0.00
4     Breakfast Spot  0.00



----Founougo----
              venue  freq
0  Food & Drink Shop  0.33
1   Botanical Garden  0.17
2           Bus Stop  0.17
3            Market   0.17
4  Seafood Restaurant  0.17



----Gomparou----
              venue  freq
0  Food & Drink Shop  0.4
1           Bus Stop  0.2
2            Market   0.2
3             Plaza   0.2
4   Botanical Garden  0.0
```

Abomey-Calavi:

```
----Akassato----
                      venue  freq
0              Shopping Mall  0.08
1                     Resort  0.08
2                      Hotel  0.08
3  Middle Eastern Restaurant  0.05
4                     Bakery  0.05


----Glo-Djigbé----
                      venue  freq
0              Shopping Mall  0.08
1                     Resort  0.08
2                      Hotel  0.08
3  Middle Eastern Restaurant  0.05
4                     Bakery  0.05


----Godomey----
                      venue  freq
0              Shopping Mall  0.08
1                     Resort  0.08
2                      Hotel  0.08
3  Middle Eastern Restaurant  0.05
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43	Soroko	0	0	0	0	1	0	0	0	0
45	Soroko	0	0	1	0	0	0	0	0	0
17	Goumori	0	1	0	0	0	0	0	0	0
21	Kokey	0	0	0	0	0	0	0	0	1
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125	Godomey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
327	Zinvié	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
74	Glo-Djigbé	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
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0     Food & Drink Shop  0.33
1      Botanical Garden  0.17
2             Bus Stop  0.17
3               Market  0.17
4  Seafood Restaurant  0.17


----Gomparou----
              venue  freq
0  Food & Drink Shop   0.4
1           Bus Stop   0.2
2             Market   0.2
3             Plaza   0.2
4  Botanical Garden   0.0
```

Abomey-Calavi:

```
----Akassato----
                     venue  freq
0           Shopping Mall  0.08
1                  Resort  0.08
2                   Hotel  0.08
3  Middle Eastern Restaurant  0.05
4                  Bakery  0.05


----Glo-Djigbé----
                     venue  freq
0           Shopping Mall  0.08
1                  Resort  0.08
2                   Hotel  0.08
3  Middle Eastern Restaurant  0.05
4                  Bakery  0.05


----Godomey----
                     venue  freq
0           Shopping Mall  0.08
1                  Resort  0.08
2                   Hotel  0.08
3  Middle Eastern Restaurant  0.05
4                  Bakery  0.05
```

From this result we obtain the following clustering of the neighbourhoods based on the category type of the venues **Banikoara:**

	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
3	Goumori	0	Steakhouse	Plaza	Breakfast Spot
4	Kokey	0	Steakhouse	Plaza	Market
5	Kokiborou	0	Food & Drink Shop	Steakhouse	Plaza
6	Ounet	0	Food & Drink Shop	Plaza	Market
9	Toura	0	Food & Drink Shop	Steakhouse	Plaza

	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Banikoara	1	Food & Drink Shop	Plaza	Market
1	Founougo	1	Food & Drink Shop	Seafood Restaurant	Market
2	Gomparou	1	Food & Drink Shop	Plaza	Market
7	Sompérékou	1	Food & Drink Shop	Plaza	Market
8	Soroko	1	Food & Drink Shop	Plaza	Market

With less quality data we can infer here that in Banikoara a region situated in the northern part of Benin that the three first common venue of interest are : Food & Drink Shop, Plaza and Market The result is quite understandable because this part of the country abounds of farming land as mentioned in the introduction due to the remote character of the region. Moreover, for clarification this venue is full of small business that helps families survive and covers the daily business.

Abomey-Calavi:

	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Abomey-Calavi	0	Shopping Mall	Resort	Hotel
1	Akassato	0	Shopping Mall	Resort	Hotel
2	Glo-Djigbé	0	Shopping Mall	Resort	Hotel
3	Godomey	0	Shopping Mall	Resort	Hotel
5	Kpanroun	0	Shopping Mall	Resort	Hotel
6	Ouédo	0	Shopping Mall	Resort	Hotel
7	Togba	0	Shopping Mall	Resort	Hotel
8	Zinvié	0	Shopping Mall	Resort	Hotel

	Neighborhood	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
4	Hévié	1	Shopping Mall	Resort	Bakery

We could notice here from the clustering of neighbourhoods in the southern part we have more of shopping mall, resort and hotels venue. Which is understandable since this part of the country is in consistent development and very frequented by young people and foreigners. We must also clarify here that the discovered venues are very big business because of the character expensive of services offered.

On a map this gives us the following views **Banikoara:**
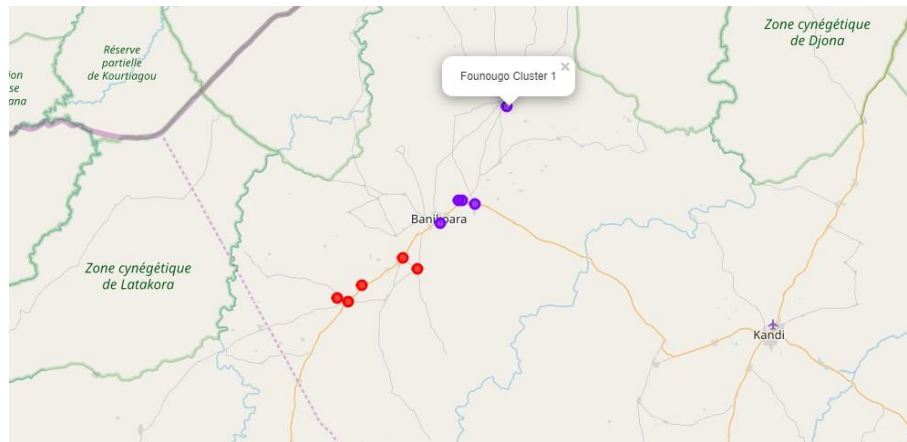
Abomey-Calavi:
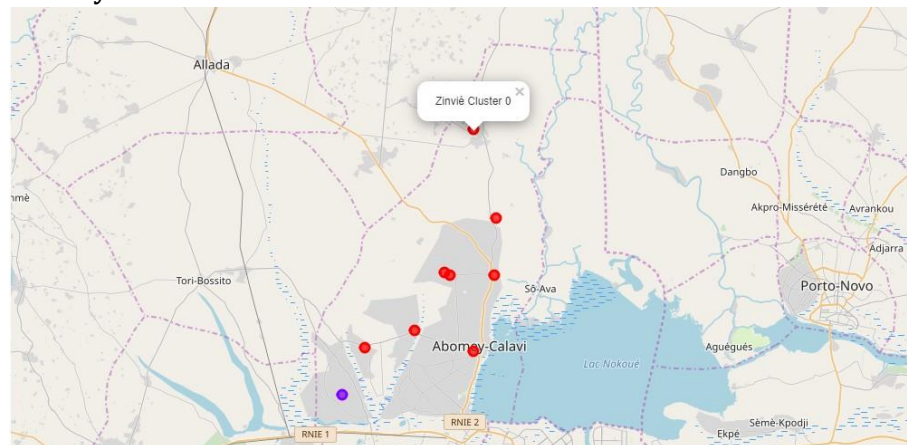
In summary the result of clustered neighbourhoods per region showed us a distribution of venues as follow:

Considering the three most common venues, in Banikoara we have various venues with dominant venues being: Food & Drinks shop, Plaza and Market. On the other hand, in Abomey Calavi we have a very consistent dominance of venues such as: Shopping Mall, Resort and Hotels.

Considering that the turnover of venues in the northern part of Benin is around 5% of the ones in the southern part. These results first suggest the potential needs to invest in such sector of activities in the northern part of the country. And second the real lack of such business opportunities that entrepreneurs, foreign investors, authorities should exploit for the benefits of all (citizens and the different actors) and a balance found between the business activities of the south and the north.

6   Discussions

As all human work is not perfect, we discuss here some results we obtain, not to discredit them but to put a bit of abstention on the certainty of those results although Beninese would agree with me that this current problem of distribution of infrastructures or services prevail in the country.

First, we discuss here the quality of our dataset used for the geocoding of department, borough and neighbourhoods. We were able to download a sample dataset meaning we were limited in our search. If allowed to have the full list we would have gear this study toward a comparison between the city of Cotonou and Parakou for more consistent results.

Second, we used foursquare API to obtain the neighbourhoods and venues of each region. The choice of radius as mentioned above is very detrimental of the quality of neighbourhoods and venues obtained. Here we wish to have perform our query within a radius of 500 for concise and accurate result. Nevertheless, the obtained also reveals the necessity to geocode venues and places in the whole territory of Benin. For instance, in our study for Banikoara we identify 9 unique venues in the region and for Abomey-Calavi we got 28 unique venues. This work is in progress and we hope to obtain more data and surely open data.

Third, we clustered the neighbourhoods based on the frequency of occurrences of venues using K-means. As mentioned above it was best if the choice of k was done using the elbow method. Plus, due to the number of parameters to consider in characterizing small or big business we found in our clusters certain of our affirmation needs to be carefully scrutinize with more data at hand.

In the end, we consider the obtained result to serve as a support that could be expanded to other cities like Cotonou and Parakou with the availability of open data. As usual, in such studies the accessibility and quality of data sometimes gear to the obtainment of very appealing results.

7 Conclusion

In a nutshell, we clearly see here that the northern part of Benin is the centre of business activities that revolves mainly around Food & Drinks Shop, Plaza and Markets. Activities which we consider as small business. On the other hand, in the southern part we were able to highlight venues such as: Shopping mall, Resort and Hotels which we consider as big business. As a result, investors and Beninese are invited to explore for business on the other side of the country (north) this with respect of feasibility study and good marketing of your business for both winning party your business profits and the development of Benin.