Predicting the best Dublin neighborhoods to live in

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1. Introduction

1.1 Background

Dublin has overtaken Paris for the first time to become the fifth most expensive place for an expat to rent a home in Europe, according to a new survey. The research, published by global mobility expert ECA International, found that the average rental price for an unfurnished, mid-range, three-bedroom apartment in Dublin targeting the expat market, has risen to € 3,406 a month. This puts Dublin behind London, Moscow, Zurich and Geneva, and compares with an average rent of €3,324 for Paris.

"The past 10 years have seen a significant turnaround in the fortunes of Dublin's residential rental market. The global financial crisis exposed a property bubble in the Irish capital and rents have increased significantly with each subsequent year of recovery. The cost of renting has also been affected by elevated demand from international companies relocating staff while looking to take advantage of Ireland's low corporate tax rate", said Alec Smith, accommodation services manager, ECA International.

Dublin's rise in the ranking is also widely seen as a function of its emergence as one of the "winners" to emerge from the migration of financial services businesses out of London in the lead-up to Brexit.

1.2 Problem

There is a need to identify Dublin neighborhoods where the costs of living are affordable for mid-range expats. Specifically, it is important to analyze the neighborhoods well connected to the center of this city by the different types of transport in relation to the availability of the services present, the costs of rents and the crime rate.

The question to be answered is: *"What are the best neighborhoods to choose to live in based on crime rate, rental cost, transport and available services?"*

1.3 Stakeholders

This study is of interest to any average person intending to immigrate to Dublin, having to assess the area where he would preferably reside.

2. Data acquisition and cleaning

2.1 Data sources

To obtain data on house/apartment purchases in each district of Dublin in the year 2020 (specifically, up to 18/11/2020), the dataset created by the Property Services Regulatory Authority (PSRA) in .csv format was used, identified as "PPR-2020-Dublin". This dataset consists of:

- date of sale;
- address of the house sold;
- postcode;
- country;
- price;
- description of the property and its size.

A location data provider with information about all manner of venues and events within an area of interest, called Foursquare, was also used to extract information of venues within a specified distance of the longitude and latitude of each postcode. The information obtained per venue are the following:

- name of the neighborhood;
- neighborhood latitude;
- neighborhood longitude;
- name of the venue;
- venue latitude;
- venue longitude;
- venue category.

In addition, data on the crime rates of North and South Dublin for the year 2019 published by the popular Irish newspaper "The Irish Time" were collected.

2.2 Data Cleaning and Feature Selection

Data on the crime rates and on house/apartment purchases were combined into one table, considering Dublin 1, Dublin 3, Dublin 5, Dublin 7, Dublin 9, Dublin 11, Dublin 13, Dublin 15, Dublin 17 as North Dublin and the other postal codes as South Dublin.

The properties with prices that were not full market price and irrelevant columns (Date of Sale, Address, County, Not Full Market Price, VAT Exclusive, Description of Property, Property Size Description) have been removed. Subsequently, the rows with no postal code were deleted and the column with the house prices was renamed as *Price* for convenience.

Part of each price string was replaced so that later it could be converted to float (useful in future analyzes). The rows have been grouped by postal code and using the average of the values for each column.

Then, the prices and crime rates of each postal code were rounded and the rows were sorted by their price. Two columns containing latitude and longitude for each Dublin area have been added to the table (Table 1).

	Postal Code	Price	Crime Rate	Latitude	Longitude
1	Dublin 10	224536.12	1585.0	53.388880	-6.298660
2	Dublin 11	268652.31	2571.0	53.397680	-6.208060
8	Dublin 17	280778.36	2571.0	53.372860	-6.362640
12	Dublin 22	281295.44	1585.0	53.283080	-6.296600
11	Dublin 20	319769.22	1585.0	53.358550	-6.241240
13	Dublin 24	327107.64	1585.0	53.302140	-6.307270
3	Dublin 12	341282.83	1585.0	53.347910	-6.396640
19	Dublin 7	367474.03	2571.0	53.337090	-6.286560
6	Dublin 15	390048.97	2571.0	53.331760	-6.294110
16	Dublin 5	399899.22	2571.0	39.812438	-85.206081
21	Dublin 9	415166.20	2571.0	53.395660	-6.162870
14	Dublin 3	484097.64	2571.0	53.344750	-6.259250
7	Dublin 16	485729.19	1585.0	53.352930	-6.284670
18	Dublin 6w	518071.32	1585.0	53.337800	-6.233530
10	Dublin 2	570196.83	1585.0	53.383090	-6.246160
5	Dublin 14	595134.43	1585.0	53.395900	-6.127860
9	Dublin 18	712892.29	1585.0	53.382720	-6.206270
0	Dublin 1	719180.77	2571.0	53.342400	-6.355760
15	Dublin 4	728728.84	1585.0	53.301570	-6.245520
20	Dublin 8	823076.84	1585.0	53.331570	-6.254480
17	Dublin 6	871080.95	1585.0	53.348140	-6.257400
4	Dublin 13	882561.02	2571.0	53.351430	-6.378080

Table 1 - Table with average home prices, crime rates and coordinates of each Dublin neighborhood

Dublin nearby venues were also extracted through Foursquare using 30 records as a limit for each request (to avoid running out of requests to be made with a free account) and using a distance of up to 700 meters from each neighborhood. Specifically, two tables were created, one with the locations of the primary services (Table 2) and the other with all the venues close to each individual zone (Table 3). The primary service locations considered are: Bike Rental / Bike Share, Bus Station, Bus Stop, Metro Station, Tram Station, Train Station, Grocery Store, Supermarket, Dairy Store, Pharmacy, Hospital and Emergency Room.

	Neighborhood Name	Neighborhood Latitude	Neighborhood Longitude	Venue Name	Venue Latitude	Venue Longitude	Venue Category
0	Dublin 10	53.38888	-6.29866	Book A Bus	53.389126	-6.296711	Bus Station
1	Dublin 10	53.38888	-6.29866	Iceland	53.388218	-6.297343	Grocery Store
2	Dublin 10	53.38888	-6.29866	SuperValu	53.390577	-6.298678	Supermarket
3	Dublin 10	53.38888	-6.29866	Dublin Bus Stop No 1525	53.386964	-6.297331	Bus Stop
4	Dublin 10	53.38888	-6.29866	Thurles Station	53.390079	-6.294576	Platform

Table 2 – Part of the table with information on the venues of the primary services in the vicinity of each neighborhood

	Neighborhood Name	Neighborhood Latitude	Neighborhood Longitude	Venue Name	Venue Latitude	Venue Longitude	Venue Category
0	Dublin 10	53.38888	-6.29866	Power city	53.387790	-6.298791	Department Store
1	Dublin 10	53.38888	-6.29866	Iceland	53.388218	-6.297343	Grocery Store
2	Dublin 10	53.38888	-6.29866	Costa Coffee	53.383154	-6.295827	Coffee Shop
3	Dublin 10	53.38888	-6.29866	Molloys Liquor Stores	53.389945	-6.294148	Liquor Store
4	Dublin 10	53.38888	-6.29866	Burger King	53.383866	-6.295180	Fast Food Restaurant

Table 3 – Part of the table with information on all types of venues in the vicinity of each neighborhood

The rows with missing values were eliminated and One Hot Encoding was performed on the venues categories so that the KMeans method could be applied later.

Therefore, some useless columns have been removed that were incorrectly selected from the queries to Foursquare (Bus Line, Bike Shop, Road, Deli / Bodega, Food & Drink Shop) and the venues by postal code have been grouped. The final table with only the basic necessities venues is visible in Table 4.

Postal Code	Bike Rental / Bike Share	Bus Station	Bus Stop	Department Store	Grocery Store	Hospital	Hospital Ward	Pharmacy	Platform	Supermarket	Tram Station
Dublin 1	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000
Dublin 10	0.000000	0.111111	0.222222	0.000000	0.111111	0.000000	0.000000	0.111111	0.111111	0.222222	0.000000
Dublin 11	0.000000	0.000000	0.300000	0.000000	0.100000	0.000000	0.000000	0.400000	0.000000	0.200000	0.000000
Dublin 12	0.000000	0.000000	0.000000	0.000000	0.500000	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000

Table 4 – Part of the final table with the means of each category of venues of primary services in the vicinity of each neighborhood inserted as columns

In total, there were 11.948 rows and 23 features in the raw dataset, subsequently thanks to data cleaning and the addition of columns useful for some operations such as the ones to be carried out by the KMeans method, the final dataset was composed of 28 features.

3. Methodology

The similarities between the different neighborhoods were investigated considering their proximity to each service identified as being of primary necessity, using the KMeans method for the creation of clusters to incorporate similar neighborhoods. The Elbow Method was used to identify the optimal number of clusters to create, selecting the value of k at the "elbow", ie the point after which the inertia start decreasing in a linear fashion, concluding that the optimal number of clusters for the data is 16 (Figure 1). For greater comprehensibility, the clusters were displayed on a map centered on Dublin.

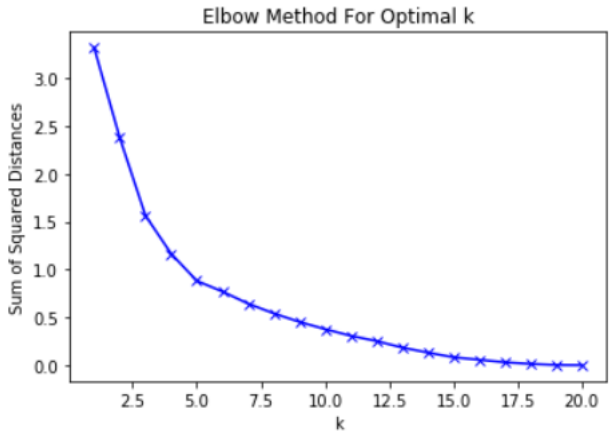

Figure 1 - Elbow Method to determine the optimal number of clusters to be used in KMeans (optimal k equal to 16)

Subsequently, the average prices of apartments/houses and crime rates in each Dublin neighborhood were explored using a histogram for the former and a scatter plot for the rest. The five top venues were also analyzed considering all nearby venues (not only the services of primary necessity) in order to have a general vision for the choice of the best neigborhood based on the greater presence of some venues. This was done by generating columns according to number of top venues and creating a new table with five top venues for each Dublin neighborhood.

4. Results

4.1 Similarities between neighborhoods

In Table 5 it is possible to observe the division of the neighborhoods into 16 clusters:

- Cluster 0: Dublin 1, Dublin 9;
- Cluster 1: Dublin 15, Dublin 20;
- Cluster 2: Dublin 8;
- Cluster 3: Dublin 16;
- Cluster 4: Dublin 4;
- Cluster 5: Dublin 13;
- Cluster 6: Dublin 24;
- Cluster 7: Dublin 11, Dublin 14, Dublin 17;
- Cluster 8: Dublin 22;
- Cluster 9: Dublin 3, Dublin 6;
- Cluster 10: Dublin 18;
- Cluster 11: Dublin 2;
- Cluster 12: Dublin 12;
- Cluster 13: Dublin 10;
- Cluster 14: Dublin 7;
- Cluster 15: Dublin 6w.

	Postal Code	Cluster Labels	Bike Rental / Bike Share	Bus Station	Bus Stop	Department Store	Grocery Store	Hospital	Hospital Ward	Pharmacy	Platform	Supermarket	Tram Station
0	Dublin 1	0	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000
1	Dublin 10	13	0.000000	0.111111	0.222222	0.000000	0.111111	0.000000	0.000000	0.111111	0.111111	0.222222	0.000000
2	Dublin 11	7	0.000000	0.000000	0.300000	0.000000	0.100000	0.000000	0.000000	0.400000	0.000000	0.200000	0.000000
3	Dublin 12	12	0.000000	0.000000	0.000000	0.000000	0.500000	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000
4	Dublin 13	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
5	Dublin 14	7	0.000000	0.000000	0.333333	0.000000	0.000000	0.000000	0.000000	0.333333	0.000000	0.333333	0.000000
6	Dublin 15	1	0.000000	0.000000	0.000000	0.000000	0.500000	0.166667	0.000000	0.000000	0.000000	0.166667	0.000000
7	Dublin 16	3	0.000000	0.000000	0.142857	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.571429	0.142857
8	Dublin 17	7	0.000000	0.000000	0.333333	0.000000	0.000000	0.000000	0.000000	0.500000	0.000000	0.166667	0.000000
9	Dublin 18	10	0.000000	0.000000	0.333333	0.000000	0.333333	0.000000	0.000000	0.000000	0.000000	0.333333	0.000000
10	Dublin 2	11	0.000000	0.000000	0.250000	0.000000	0.500000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
11	Dublin 20	1	0.000000	0.000000	0.000000	0.000000	0.555556	0.000000	0.000000	0.000000	0.000000	0.222222	0.000000
12	Dublin 22	8	0.000000	0.000000	0.500000	0.000000	0.000000	0.250000	0.000000	0.000000	0.000000	0.000000	0.000000
13	Dublin 24	6	0.000000	0.000000	0.666667	0.000000	0.222222	0.000000	0.000000	0.111111	0.000000	0.000000	0.000000
14	Dublin 3	9	0.075000	0.000000	0.225000	0.012500	0.187500	0.000000	0.000000	0.112500	0.000000	0.087500	0.087500
15	Dublin 4	4	0.000000	0.000000	0.333333	0.000000	0.000000	0.000000	0.000000	0.666667	0.000000	0.000000	0.000000
16	Dublin 6	9	0.075269	0.010753	0.236559	0.010753	0.172043	0.010753	0.000000	0.064516	0.000000	0.096774	0.118280
17	Dublin 6w	15	0.166667	0.083333	0.166667	0.000000	0.083333	0.000000	0.000000	0.333333	0.000000	0.083333	0.000000
18	Dublin 7	14	0.076923	0.000000	0.076923	0.000000	0.230769	0.153846	0.076923	0.000000	0.000000	0.153846	0.153846
19	Dublin 8	2	0.185185	0.037037	0.333333	0.000000	0.074074	0.037037	0.000000	0.111111	0.000000	0.037037	0.111111
20	Dublin 9	0	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000	0.000000	0.250000	0.000000	0.250000	0.000000

Table 5 - Table with the means of the categories of venues of primary services present in the vicinity of each neighbourhood, and clusters to which they have been associated

Cluster 9 groups neighborhoods in which there is a greater variety of primary services (Table 6), followed by Clusters 2, 15 and 14.

	Postal Code	Cluster Labels	Bike Rental / Bike Share	Bus Station	Bus Stop	Department Store	Grocery Store	Hospital	Hospital Ward	Pharmacy	Platform	Supermarket	Tram Station
14	Dublin 3	9	0.075000	0.000000	0.225000	0.012500	0.187500	0.000000	0.0	0.112500	0.0	0.087500	0.08750
16	Dublin 6	9	0.075269	0.010753	0.236559	0.010753	0.172043	0.010753	0.0	0.064516	0.0	0.096774	0.11828

Table 6 - Table with the means of the categories of venues of primary services present in the vicinity of the neighborhoods associated with Cluster 9

The clusters are visible on the map in Figure 2.

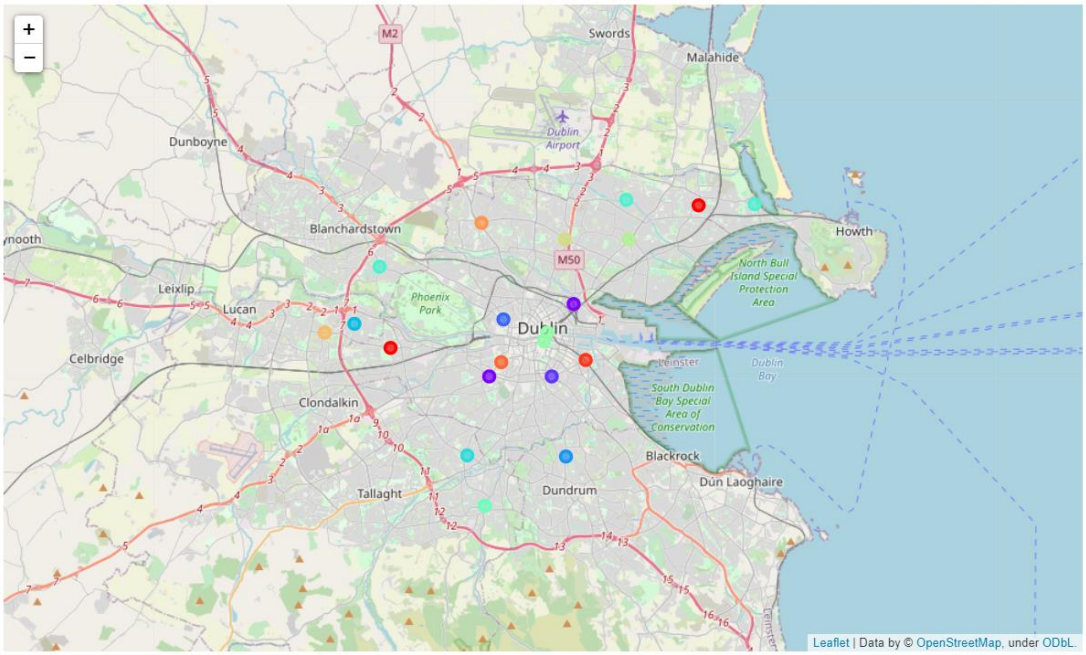

Figure 2 - Dublin map with markers for the different clusters

4.2 Average prices of apartments/houses and crime rates in Dublin neighborhoods

In Figure 3 it is possible to see that the average cheapest houses/apartments are present in Dublin 10, followed by Dublin 11 and Dublin 17. Instead the recorded crime rate is much lower in South Dublin (Figure 4).

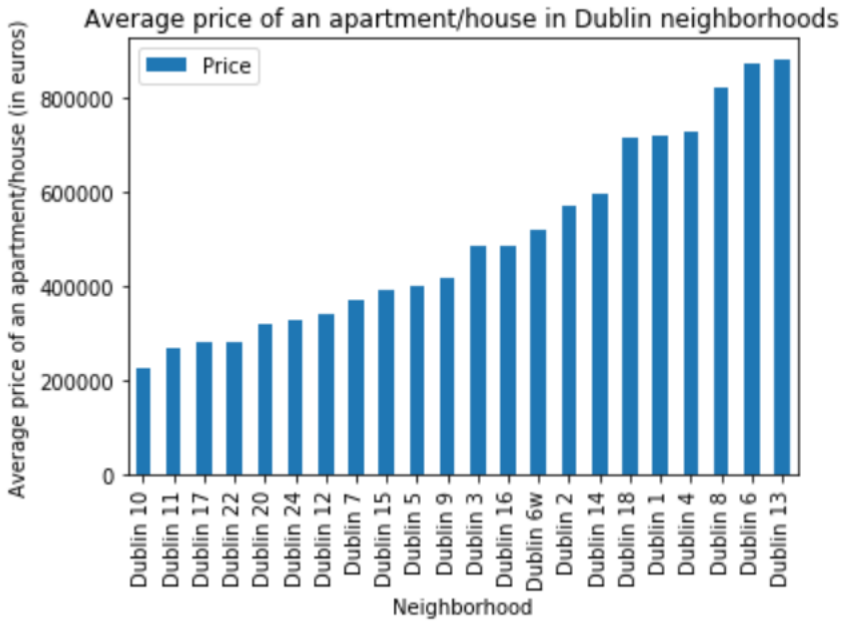

Figure 3 - Average prices of apartments/houses in Dublin neighborhoods

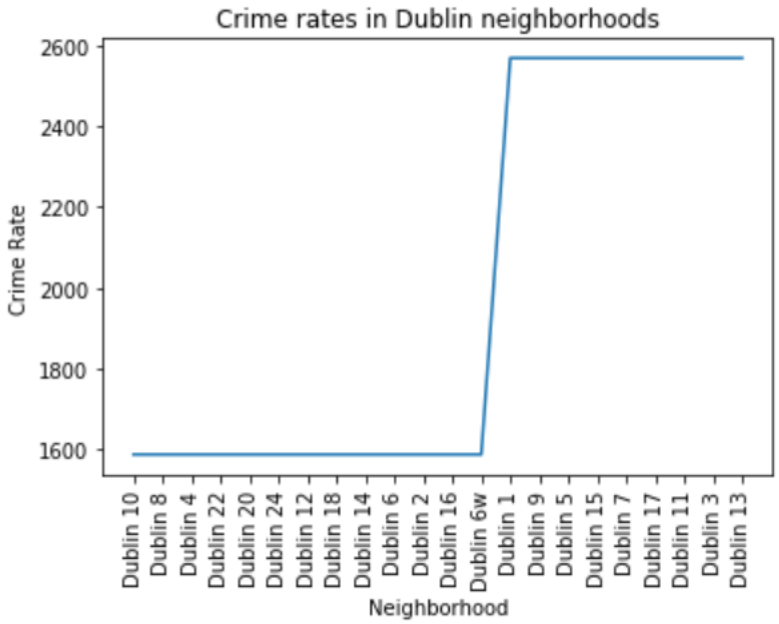

Figure 4 - Crime rates in Dublin neighborhoods

4.3 Five top venues for each neighborhood

Thanks to Table 7, each expat can have a global view of the five venues most present in each neighborhood, this was done in order to guarantee him an extra means to select the area of Dublin he would prefer to move to. The choice in this case is entirely personal.

	Postal Code	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Dublin 1	Gym / Fitness Center	Burger Joint	Chinese Restaurant	Farm	Bar
1	Dublin 10	Department Store	Electronics Store	Supermarket	Fast Food Restaurant	Grocery Store
2	Dublin 11	Supermarket	Café	Coffee Shop	Discount Store	Sandwich Place
3	Dublin 12	Mobile Phone Shop	Coffee Shop	Electronics Store	Fast Food Restaurant	Burger Joint
4	Dublin 13	Supermarket	Convenience Store	Gym	Bowling Alley	Shopping Mall
5	Dublin 14	Pub	Convenience Store	Supermarket	Gastropub	Bar
6	Dublin 15	Grocery Store	Pub	Chinese Restaurant	Café	Garden
7	Dublin 16	Supermarket	History Museum	Hotel	Pub	Bistro
8	Dublin 17	Café	Pub	Italian Restaurant	Asian Restaurant	Convenience Store
9	Dublin 18	Supermarket	Grocery Store	Bus Stop	Convenience Store	Pub
10	Dublin 2	Pub	Betting Shop	Grocery Store	Coffee Shop	Burger Joint
11	Dublin 20	Convenience Store	Pub	Grocery Store	Supermarket	Fast Food Restaurant
12	Dublin 22	Golf Course	Bus Stop	Convenience Store	Pizza Place	Falafel Restaurant
13	Dublin 24	Liquor Store	Coffee Shop	Pub	Convenience Store	Asian Restaurant
14	Dublin 3	Pub	Coffee Shop	Restaurant	Italian Restaurant	Cocktail Bar
15	Dublin 4	Pub	Light Rail Station	Fast Food Restaurant	Thai Restaurant	Bakery
16	Dublin 5	Baseball Field	Moving Target	Music Venue	Auto Garage	Yoga Studio
17	Dublin 6	Pub	Coffee Shop	Café	Clothing Store	Bookstore
18	Dublin 6w	Pub	Café	Hotel	Bar	Coffee Shop
19	Dublin 7	Brewery	Bar	Gym	Grocery Store	Restaurant
20	Dublin 8	Coffee Shop	Café	Hotel	Restaurant	Pub
21	Dublin 9	Supermarket	Fast Food Restaurant	Train Station	Grocery Store	Shopping Mall

Table 7 – Table with the five top venues categories for each neighborhood

5. Discussion

There is no perfect area to live in, so it is sometimes important to start from some personal criteria for a correct choice. For example, excluding the areas with a higher crime rate, we can define Dublin 6w as the best neighborhood in which house prices are average (around 518.071 euros) and which has a good variety of basic necessities. Also, the most common venue in this area are pubs, where Irish people usually go in their spare time. Immigrants could therefore make friends more easily as soon as they arrive in Ireland.

6. Conclusions

In this study, Dublin neighborhoods were analyzed in order to help immigrants choose the best area to live in based on the cost of housing, crime rate and services offered. In this regard, KMeans (with 16 clusters) were used to understand if there were any similarities, for primary services offered, between neighborhoods. Subsequently, the average costs for the purchase of houses and the crime rate recorded in those areas were evaluated.

In addition, an analysis was conducted on the overall services offered by each area, obtaining the five most present services. This could be used by individual immigrants as an additional means of choosing which area to live in based on their personal preferences.

7. Future directions

In future, it would be possible to extend this analysis to a greater number of venues, excluded due to the restrictions of the free account of Foursquare, and the best areas could be evaluated for specific groups of individuals. In the case of families with children, it could also be relevant to evaluate the ratings of each school in the vicinity of each area.