

# 1. Introduction

## 1.1 Case Description

In this project I will try to find an optimal location for a cafeteria in my hometown, in Thessaloniki, Greece. This report facilitates the market analysis of this type of store and targets the stakeholders to evaluate the situation.

Since there are lots of cafes in Thessaloniki, I will try to detect locations that are not already crowded with cafes, or there is a lot of potential due to their location in comparison with the customers traffic. Another factor is to check the existence of other cafes in vicinity, which would affect our total sales.

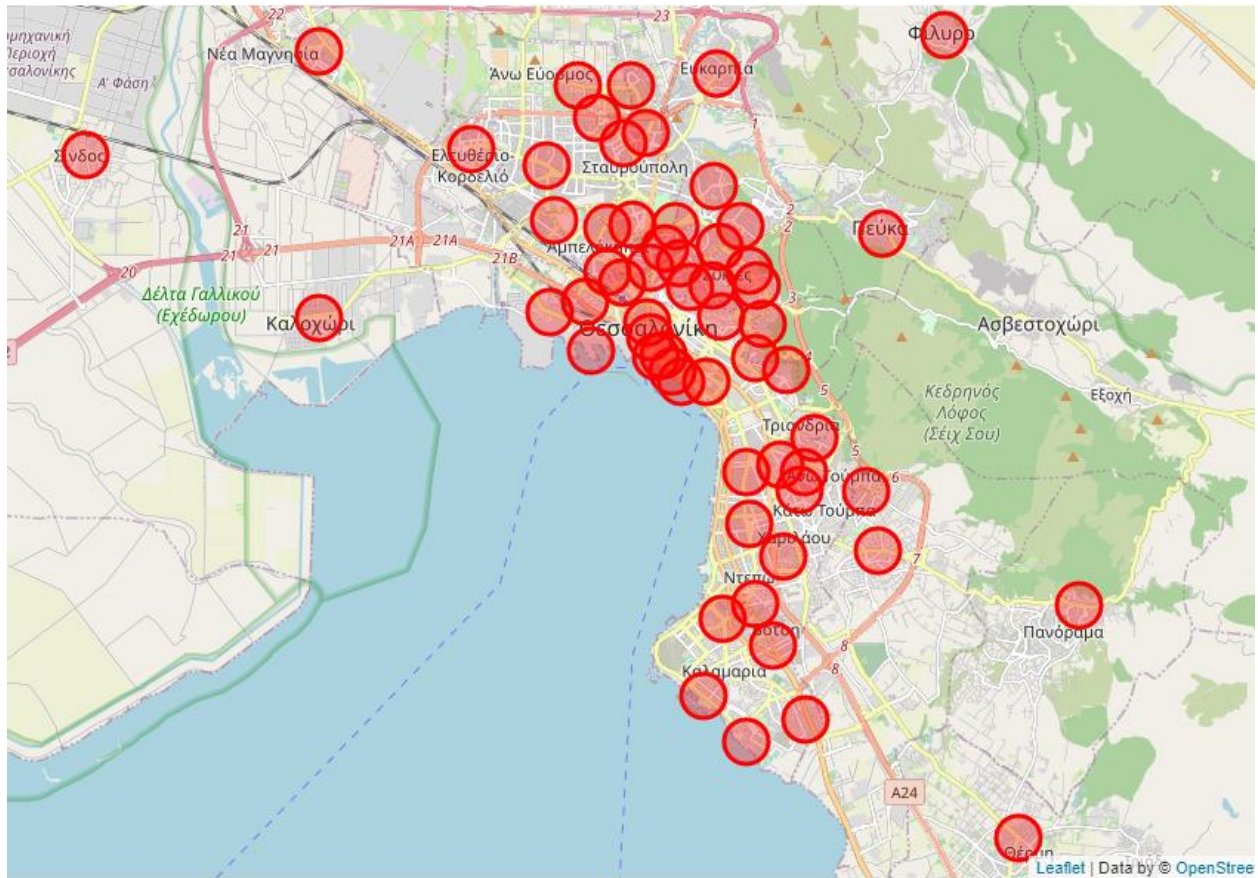
I will utilize the Clustering analysis to detect some promising spots in crowded neighborhoods based on the upper criteria. The final step will point out the best locations **if not the only one**.

## 1.2 Discussion of the Background

Thessaloniki is the second largest city in Greece after capital Athens, having about 1 million people live, in an area of 1,285 km<sup>2</sup> and city density of 7,100 residents per square kilometer. The city is divided into 7 districts in total. However, the biggest municipal unit is the center of the town with 1/3 of the total population to live there.

As you can see from the picture (municipals are marked with green dot), Thessaloniki is a city with a relatively high population density. Being such a crowded city leads the owners of shops and social sharing places in the city where the population is dense. When we think of it as an investor, I would prefer those districts where there is a lower real estate cost (not in scope of this research) and the type of business they want to initiate is less intense. However, it is difficult to obtain information to the full extent as our means of research are limited to the foursquare listed locations.

When we consider all these problems, we can create a map and information chart where the real estate index is placed on Istanbul and each district is clustered according to the venue density.



## 2. Data Description

This business case has been drop-downed to its core elements:

As presented above, the map of Thessaloniki has been splitted into its boroughs, where Wikipedia and Google Maps have been used as a primary source. Each borough has 4 properties:

- the municipal unit that it belongs
- the longitude
- the latitude
- the approximately the number of inhabitants (as per population census of 2011)

One drawback is that there is not so much data available, therefore I have to look into multiple sites to formulate the data tables.

Secondly, I used Forsquare API to get the most common venues of given Borough of Thessaloniki.

Lastly, I used Google Map, 'Search Nearby' option to get the center coordinates of the each Borough as well as to compare to the given venues.

### 3. Methodology

I stored the dataset on GitHub repository. The columns of the dataset consist of the borough, the longitude, the latitude and the population.

	Municipal Unit	Borough	Latitude	Longitude	Pop
0	Thermi	Thermi	40.550252	23.021072	53201
1	Stavroupoli	Nikopoli	40.682636	22.931380	7452
2	Stavroupoli	Stavroupoli	40.672539	22.929546	27084
3	Sindos	Sindos	40.670536	22.804609	9289
4	Sikies	Sikies	40.647503	22.960524	22544

Next step is to connect to Foursquare Api and get all venues in a radius of 500m for the given Boroughs.

---- Agia Triada has 43 venues and a population of 8861 ----

	venue	freq
0	Café	0.12
1	Coffee Shop	0.07
2	Greek Restaurant	0.07
3	Theater	0.05
4	Hotel	0.05
5	Sandwich Place	0.05
6	Pizza Place	0.05
7	Bar	0.05
8	Beer Bar	0.05
9	Gym	0.05

---- Agios Pavlos has 39 venues and a population of 6852 ----

	venue	freq
0	Café	0.13
1	Greek Restaurant	0.10
2	Castle	0.08
3	Plaza	0.05
4	Supermarket	0.05
5	Dessert Shop	0.05
6	Meze Restaurant	0.05
7	Vacation Rental	0.05
8	Bar	0.05
9	Snack Place	0.03

---- Agios Fanourios has 38 venues and a population of 19096 ----

	venue	freq
0	Greek Restaurant	0.13
1	Meze Restaurant	0.08
2	Fast Food Restaurant	0.05
3	Café	0.05
4	Bus Stop	0.05
5	Coffee Shop	0.05
6	Pizza Place	0.05
7	Supermarket	0.05
8	Bowling Alley	0.03
9	Other Nightlife	0.03

---- Ampelokipoi has 42 venues and a population of 14532 ----

	venue	freq
0	Café	0.14
1	Greek Restaurant	0.14
2	Supermarket	0.07
3	Bar	0.07
4	Bus Stop	0.05
5	Bakery	0.05
6	Stadium	0.02
7	Ice Cream Shop	0.02
8	Grocery Store	0.02
9	Gym	0.02

---- Anagennisi has 21 venues and a population of 3756 ----

	venue	freq
0	Mobile Phone Shop	0.10
1	Café	0.10
2	Dessert Shop	0.10
3	Kafenio	0.05
4	Plaza	0.05
5	Pedestrian Plaza	0.05
6	Park	0.05
7	Snack Place	0.05
8	Ouzeri	0.05
9	Bus Stop	0.05

---- Analipsi has 38 venues and a population of 19459 ----

	venue	freq
0	Café	0.16
1	Supermarket	0.11
2	Fast Food Restaurant	0.08
3	Meze Restaurant	0.05
4	Greek Restaurant	0.05
5	Coffee Shop	0.05
6	Gym / Fitness Center	0.05
7	Electronics Store	0.05
8	Bougatsa Shop	0.03
9	Nightlife Spot	0.03

---- Ano Ilioupoli has 18 venues and a population of 6994 ----

	venue	freq
0	Café	0.17
1	Greek Restaurant	0.11
2	Fast Food Restaurant	0.11
3	Dessert Shop	0.06

---- Aretsou has 49 venues and a population of 4164 ----

	venue	freq
0	Café	0.27
1	Greek Restaurant	0.06

4	Bakery	0.06
5	Gym / Fitness Center	0.06
6	Taverna	0.06
7	Food Truck	0.06
8	Beer Bar	0.06
9	Ouzeri	0.06

---- Ano Poli has 36 venues and a population of 19154 ----

	venue	freq
0	Greek Restaurant	0.17
1	Meze Restaurant	0.08
2	Café	0.08
3	Supermarket	0.06
4	Park	0.06
5	Fruit & Vegetable Store	0.06
6	Restaurant	0.03
7	Bus Stop	0.03
8	Gym	0.03
9	Grilled Meat Restaurant	0.03

---- Ano Toumpa has 38 venues and a population of 27613 ----

	venue	freq
0	Greek Restaurant	0.21
1	Meze Restaurant	0.13
2	Coffee Shop	0.08
3	Souvlaki Shop	0.05
4	Fast Food Restaurant	0.05
5	Café	0.03
6	Soccer Stadium	0.03
7	Sporting Goods Shop	0.03
8	Pool	0.03
9	Snack Place	0.03

2	Seafood Restaurant	0.06
3	Souvlaki Shop	0.04
4	Beer Bar	0.04
5	Fish Taverna	0.04
6	Ouzeri	0.04

7	Bar	0.04
8	Shipping Store	0.02
9	Boat or Ferry	0.02

---- Aristoteleio has 22 venues and  
a population of 4550 ----

	venue	freq
0	Café	0.23
1	Bus Stop	0.09
2	Greek Restaurant	0.09
3	Lounge	0.09
4	Supermarket	0.09
5	Pool	0.09
6	Gastropub	0.05
7	Art Museum	0.05
8	Volleyball Court	0.05
9	Bakery	0.05

---- Aristotelous has 100 venues and  
a population of 4855 ----

	venue	freq
0	Café	0.12
1	Dessert Shop	0.06
2	Hotel	0.05
3	Bar	0.05
4	Indie Movie Theater	0.04
5	Coffee Shop	0.04
6	Bakery	0.03
7	Pizza Place	0.03
8	Greek Restaurant	0.03
9	Gourmet Shop	0.03

---- Arxaia Agora has 55 venues and  
a population of 18486 ----

	venue	freq
0	Café	0.18
1	Bar	0.09
2	Hotel	0.05
3	Meze Restaurant	0.05
4	Historic Site	0.04
5	Greek Restaurant	0.04

6	Coffee Shop	0.04
7	Taverna	0.04
8	Gourmet Shop	0.02
9	Breakfast Spot	0.02

---- Charilaou has 58 venues and a p  
opulation of 27623 ----

	venue	freq
0	Coffee Shop	0.07
1	Bakery	0.07
2	Café	0.07
3	Snack Place	0.07
4	Fast Food Restaurant	0.05
5	Gym / Fitness Center	0.05
6	Greek Restaurant	0.05
7	Park	0.03
8	Supermarket	0.03
9	Grocery Store	0.03

---- Depot has 28 venues and a popul  
ation of 19302 ----

	venue	freq
0	Gym / Fitness Center	0.11
1	Café	0.07
2	Dessert Shop	0.07
3	Supermarket	0.07
4	Gym	0.04
5	Bar	0.04
6	Taverna	0.04
7	Bistro	0.04
8	Park	0.04
9	Bridge	0.04

---- Efkarpiia has 16 venues and a po  
pulation of 13905 ----

	venue	freq
0	Café	0.25
1	Fast Food Restaurant	0.12
2	Fish Taverna	0.06
3	Basketball Stadium	0.06
4	Soccer Field	0.06

5	Bakery	0.06
6	Concert Hall	0.06
7	Salon / Barbershop	0.06
8	Grilled Meat Restaurant	0.06
9	Furniture / Home Store	0.06

---- Eleftherio-Kordelio has 23 venues and a population of 27067 ----

	venue	freq
0	Mobile Phone Shop	0.13
1	Jewelry Store	0.09
2	Café	0.09
3	Supermarket	0.09
4	Bar	0.04
5	Bus Stop	0.04
6	Furniture / Home Store	0.04
7	Donut Shop	0.04
8	Soccer Field	0.04
9	Coffee Shop	0.04

---- Elpida has 36 venues and a population of 3783 ----

	venue	freq
0	Café	0.14
1	Bar	0.14
2	Souvlaki Shop	0.06
3	Snack Place	0.06
4	Pool	0.06
5	Gym	0.06
6	Meze Restaurant	0.06
7	Mobile Phone Shop	0.06

---- Evosmos has 50 venues and a population of 49902 ----

	venue	freq
0	Bar	0.12
1	Café	0.10
2	Snack Place	0.08
3	Fast Food Restaurant	0.06
4	Meze Restaurant	0.06
5	Bakery	0.04

8	Bus Stop	0.03
9	Ouzeri	0.03

---- Eptapirgio has 18 venues and a population of 6710 ----

	venue	freq
0	Café	0.17
1	Beer Bar	0.11
2	Snack Place	0.06
3	Fast Food Restaurant	0.06
4	Gym Pool	0.06
5	Basketball Stadium	0.06
6	Mobile Phone Shop	0.06
7	Taverna	0.06
8	Hotel	0.06
9	Theater	0.06

---- Evaggelistria has 24 venues and a population of 14120 ----

	venue	freq
0	Café	0.25
1	Pizza Place	0.08
2	Snack Place	0.08
3	Greek Restaurant	0.08
4	Meze Restaurant	0.08
5	Kafenio	0.04
6	Tsipouro Restaurant	0.04
7	Church	0.04
8	Garden	0.04
9	Supermarket	0.04

6	Greek Restaurant	0.04
7	Coffee Shop	0.04
8	Mobile Phone Shop	0.04
9	Gym	0.04

---- Filiro has 7 venues and a population of 13052 ----

	venue	freq
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0	Bar	0.29
1	Greek Restaurant	0.29
2	Convenience Store	0.14
3	Pizza Place	0.14
4	Café	0.14
5	Pedestrian Plaza	0.00
6	Outdoors & Recreation	0.00
7	Outlet Mall	0.00
8	Ouzeri	0.00
9	Paella Restaurant	0.00

---- Finikas has 19 venues and a population of 6941 ----

	venue	freq
0	Gym	0.16
1	Fast Food Restaurant	0.11
2	Bakery	0.11
3	Coffee Shop	0.05
4	Pharmacy	0.05
5	Taxi Stand	0.05
6	Clothing Store	0.05
7	Gym / Fitness Center	0.05
8	Sandwich Place	0.05
9	Farmers Market	0.05

---- Frangon has 70 venues and a population of 4594 ----

	venue	freq
0	Bar	0.13
1	Hotel	0.11
2	Cocktail Bar	0.10
3	Café	0.09
4	Greek Restaurant	0.07
5	Restaurant	0.06
6	Nightclub	0.04
7	Bakery	0.03
8	Gym	0.03
9	Ouzeri	0.03

---- Kalabournaki has 34 venues and a population of 5553 ----

	venue	freq
0	Seafood Restaurant	0.09
1	Dessert Shop	0.09
2	Greek Restaurant	0.09
3	Gym	0.06
4	Restaurant	0.06
5	Bar	0.06
6	Mobile Phone Shop	0.03
7	Steakhouse	0.03
8	Taverna	0.03
9	Coffee Shop	0.03

---- Kalamaria has 66 venues and a population of 57964 ----

	venue	freq
0	Café	0.17
1	Greek Restaurant	0.08
2	Supermarket	0.03
3	Soccer Field	0.03
4	Coffee Shop	0.03
5	Bougatsa Shop	0.03
6	Theater	0.03
7	Fast Food Restaurant	0.03
8	Bar	0.03
9	Gastropub	0.03

---- Kalithea has 14 venues and a population of 4155 ----

	venue	freq
0	Souvlaki Shop	0.14
1	Greek Restaurant	0.14
2	Restaurant	0.07
3	Scenic Lookout	0.07
4	Gym / Fitness Center	0.07
5	Basketball Court	0.07
6	Coffee Shop	0.07
7	Vacation Rental	0.07
8	Mobile Phone Shop	0.07
9	Café	0.07

---- Kalochori has 6 venues and a population of 4672 ----

	venue	freq
0	Restaurant	0.17
1	Dessert Shop	0.17
2	Cosmetics Shop	0.17
3	Bookstore	0.17
4	Coffee Shop	0.17
5	Bar	0.17
6	American Restaurant	0.00
7	Performing Arts Venue	0.00
8	Outlet Mall	0.00
9	Ouzeri	0.00

---- Kamara has 97 venues and a population of 13993 ----

	venue	freq
0	Café	0.14
1	Bar	0.11
2	Dessert Shop	0.05
3	Coffee Shop	0.05
4	Meze Restaurant	0.04
5	Kafenio	0.04
6	Pizza Place	0.04
7	Bakery	0.03
8	Greek Restaurant	0.03
9	Pub	0.03

---- Kato Toumpa has 49 venues and a population of 29192 ----

	venue	freq
0	Café	0.14
1	Meze Restaurant	0.12
2	Coffee Shop	0.08
3	Greek Restaurant	0.06
4	Fast Food Restaurant	0.04
5	Souvlaki Shop	0.04
6	Donut Shop	0.04
7	Mobile Phone Shop	0.04
8	Gym	0.04
9	Supermarket	0.02

---- Kokkoras has 23 venues and a population of 3807 ----

	venue	freq
0	Pool	0.09
1	Basketball Court	0.09
2	Bus Stop	0.09
3	Supermarket	0.09
4	Coffee Shop	0.09
5	Café	0.04
6	Stadium	0.04
7	Ouzeri	0.04
8	Gym	0.04
9	Snack Place	0.04

---- Ksirokrini has 21 venues and a population of 6536 ----

	venue	freq
0	Dessert Shop	0.10
1	Bougatsa Shop	0.10
2	Kafenio	0.05
3	Hotel	0.05
4	Platform	0.05
5	Fast Food Restaurant	0.05
6	Furniture / Home Store	0.05
7	Snack Place	0.05
8	Café	0.05
9	Greek Restaurant	0.05

---- Ladadika has 100 venues and a population of 4626 ----

	venue	freq
0	Café	0.10
1	Bar	0.10
2	Cocktail Bar	0.06
3	Greek Restaurant	0.06
4	Hotel	0.05
5	Indie Movie Theater	0.05
6	Restaurant	0.05
7	Bakery	0.03
8	Wine Bar	0.03
9	Coffee Shop	0.03



## 9 Outdoors & Recreation 0.00

---- Louloudadika has 100 venues and a population of 4539 ----

	venue	freq
0	Café	0.12
1	Bar	0.10
2	Hotel	0.07
3	Cocktail Bar	0.06
4	Greek Restaurant	0.05
5	Indie Movie Theater	0.04
6	Coffee Shop	0.03
7	Restaurant	0.03
8	Pizza Place	0.03
9	Wine Bar	0.03

---- Malakopi has 29 venues and a population of 13483 ----

	venue	freq
0	Café	0.10
1	Greek Restaurant	0.07
2	Lounge	0.03
3	Cocktail Bar	0.03
4	Bistro	0.03
5	Hot Dog Joint	0.03
6	Taverna	0.03
7	Coffee Shop	0.03
8	Supermarket	0.03
9	Gym / Fitness Center	0.03

---- Menemeni has 8 venues and a population of 14746 ----

	venue	freq
0	Pub	0.12
1	Park	0.12
2	Plaza	0.12
3	Dessert Shop	0.12
4	Supermarket	0.12
5	Tennis Stadium	0.12
6	Gym / Fitness Center	0.12
7	Café	0.12
8	Other Nightlife	0.00

---- Meteora has 14 venues and a population of 14787 ----

	venue	freq
0	Supermarket	0.21
1	Park	0.07
2	Plaza	0.07
3	Sports Bar	0.07
4	Bougatsa Shop	0.07
5	Gourmet Shop	0.07
6	Ouzeri	0.07
7	Bus Stop	0.07
8	Café	0.07
9	Shipping Store	0.07

---- Navarinou has 85 venues and a population of 4421 ----

	venue	freq
0	Café	0.11
1	Bar	0.09
2	Dessert Shop	0.07
3	Coffee Shop	0.06
4	Pub	0.05
5	Meze Restaurant	0.04
6	Plaza	0.04
7	Candy Store	0.04
8	Donut Shop	0.02
9	Breakfast Spot	0.02

---- Nea Ionia has 12 venues and a population of 7576 ----

	venue	freq
0	Café	0.25
1	Mobile Phone Shop	0.17
2	National Park	0.08
3	Greek Restaurant	0.08
4	Pizza Place	0.08
5	Taverna	0.08
6	Gym	0.08
7	Clothing Store	0.08

8 Bakery 0.08  
 9 American Restaurant 0.00

---- Nea Krini has 15 venues and a population of 5552 ----

	venue	freq
0	Seafood Restaurant	0.27
1	Bougatsa Shop	0.13
2	Greek Restaurant	0.13
3	Park	0.13
4	Gym	0.07
5	Coffee Shop	0.07
6	Cocktail Bar	0.07
7	Café	0.07
8	Fish Taverna	0.07
9	American Restaurant	0.00

---- Nea Politia has 2 venues and a population of 24784 ----

	venue	freq
0	Coffee Shop	0.5
1	Soccer Field	0.5
2	American Restaurant	0.0
3	Pedestrian Plaza	0.0
4	Other Nightlife	0.0
5	Outdoors & Recreation	0.0
6	Outlet Mall	0.0
7	Ouzeri	0.0
8	Paella Restaurant	0.0
9	Paper / Office Supplies Store	0.0

---- Neapoli has 33 venues and a population of 10957 ----

	venue	freq
0	Mobile Phone Shop	0.12
1	Souvlaki Shop	0.06
2	Café	0.06
3	Snack Place	0.06
4	Gym	0.06
5	Park	0.06
6	Coffee Shop	0.06
7	Bus Stop	0.06
8	Restaurant	0.03
9	Pedestrian Plaza	0.03

---- Nikopoli has 4 venues and a population of 7452 ----

	venue	freq
0	Dessert Shop	0.50
1	Food Truck	0.25
2	Souvlaki Shop	0.25
3	American Restaurant	0.00
4	Patsa Restaurant	0.00
5	Other Nightlife	0.00
6	Outdoors & Recreation	0.00
7	Outlet Mall	0.00
8	Ouzeri	0.00
9	Paella Restaurant	0.00

---- Omonia has 21 venues and a population of 4478 ----

	venue	freq
0	Café	0.14
1	Supermarket	0.10
2	Beer Bar	0.05
3	Department Store	0.05
4	Pizza Place	0.05
5	Fish Taverna	0.05
6	Coffee Shop	0.05
7	Sporting Goods Shop	0.05
8	Greek Restaurant	0.05
9	Grilled Meat Restaurant	0.05

---- Oreokastro has 11 venues and a population of 25545 ----

	venue	freq
0	Park	0.18
1	Café	0.18
2	Daycare	0.09
3	Supermarket	0.09
4	Betting Shop	0.09
5	Bar	0.09
6	Convenience Store	0.09
7	Bakery	0.09
8	Gym	0.09
9	American Restaurant	0.00

---- Palaiokastro has 4 venues and a population of 12772 ----

	venue	freq
0	Supermarket	0.25
1	Kafenio	0.25
2	Greek Restaurant	0.25
3	Bakery	0.25
4	Patsa Restaurant	0.00
5	Organic Grocery	0.00
6	Other Nightlife	0.00
7	Outdoors & Recreation	0.00
8	Outlet Mall	0.00
9	Ouzeri	0.00

---- Panorama has 31 venues and a population of 17444 ----

	venue	freq
0	Bar	0.13
1	Fast Food Restaurant	0.13
2	Dessert Shop	0.10
3	Café	0.06
4	Supermarket	0.06
5	Bakery	0.06
6	Grocery Store	0.03
7	Breakfast Spot	0.03
8	Gym	0.03

---- Paralia has 86 venues and a population of 4708 ----

	venue	freq
0	Café	0.12
1	Dessert Shop	0.07
2	Coffee Shop	0.07
3	Bar	0.05
4	Hotel	0.05
5	Wine Bar	0.03
6	Seafood Restaurant	0.03
7	Plaza	0.03
8	Gourmet Shop	0.03
9	Snack Place	0.02

---- Pefka has 20 venues and a population of 13052 ----

	venue	freq
0	Supermarket	0.10
1	Grilled Meat Restaurant	0.10
2	Café	0.10
3	Flower Shop	0.10
4	Greek Restaurant	0.05
5	Bakery	0.05
6	Park	0.05
7	Bougatsa Shop	0.05
8	Snack Place	0.05
9	City	0.05

---- Polixni has 10 venues and a population of 24545 ----

	venue	freq
0	Pizza Place	0.2
1	Supermarket	0.1
2	Volleyball Court	0.1
3	Greek Restaurant	0.1
4	Souvlaki Shop	0.1
5	Bus Stop	0.1
6	Bakery	0.1
7	Basketball Court	0.1

8 Plaza 0.1  
 9 Pie Shop 0.0

---- Port has 1 venues and a population of 4747 ----

	venue	freq
0	Boat or Ferry	1
.0		
1	American Restaurant	0
.0		
2	Nightclub	0
.0		
3	Organic Grocery	0
.0		
4	Other Nightlife	0
.0		
5	Outdoors & Recreation	0
.0		
6	Outlet Mall	0
.0		
7	Ouzeri	0
.0		
8	Paella Restaurant	0
.0		
9	Paper / Office Supplies Store	0
.0		

---- Pylaia has 15 venues and a population of 34625 ----

	venue	freq
0	Café	0.13
1	Bar	0.13
2	Modern Greek Restaurant	0.07
3	Fast Food Restaurant	0.07
4	Dessert Shop	0.07
5	Italian Restaurant	0.07
6	Wine Bar	0.07
7	Fruit & Vegetable Store	0.07
8	Ouzeri	0.07
9	Greek Restaurant	0.07

---- Saranta Eklisies has 17 venues and a population of 9178 ----

	venue	freq
0	Café	0.24
1	Pool	0.12
2	Bus Stop	0.12
3	Supermarket	0.12
4	Greek Restaurant	0.12
5	Zoo	0.06
6	Music Venue	0.06
7	Plaza	0.06
8	Gastropub	0.06
9	Lounge	0.06

---- Sfageia has 20 venues and a population of 4583 ----

	venue	freq
0	Nightclub	0.30
1	Music Venue	0.15
2	Port	0.05
3	Roof Deck	0.05
4	Concert Hall	0.05
5	Hotel	0.05
6	Greek Restaurant	0.05
7	Hotel Pool	0.05
8	Shopping Mall	0.05
9	Warehouse Store	0.05

---- Sidirodromikos Stathmos has 42 venues and a population of 4780 ----

	venue	freq
0	Hotel Bar	0.07
1	Clothing Store	0.07
2	Fast Food Restaurant	0.05
3	Souvlaki Shop	0.05
4	Hotel	0.05
5	Bistro	0.02
6	Coffee Shop	0.02
7	Performing Arts Venue	0.02
8	Nightclub	0.02
9	Supermarket	0.02

9 Gym 0.03

---- Sikies has 17 venues and a population of 22544 ----

	venue	freq
0	Café	0.18
1	Beer Bar	0.12
2	Kafenio	0.06
3	Hotel	0.06
4	Ouzeri	0.06
5	Bus Stop	0.06
6	Taverna	0.06
7	Castle	0.06
8	Gym Pool	0.06
9	Soccer Stadium	0.06

---- Sindos has 16 venues and a population of 9289 ----

	venue	freq
0	Café	0.12
1	Greek Restaurant	0.06
2	Bar	0.06
3	Pizza Place	0.06
4	Fish Taverna	0.06
5	Seafood Restaurant	0.06
6	Coffee Shop	0.06
7	Park	0.06
8	Souvlaki Shop	0.06
9	Supermarket	0.06

---- Skeparni has 30 venues and a population of 3245 ----

	venue	freq
0	Café	0.13
1	Fast Food Restaurant	0.10
2	Mobile Phone Shop	0.10
3	Plaza	0.07
4	Volleyball Court	0.07
5	Coffee Shop	0.07
6	Bakery	0.07
7	Vacation Rental	0.03
8	Souvlaki Shop	0.03

---- Stavroupoli has 19 venues and a population of 27084 ----

	venue	freq
0	Café	0.11
1	Fast Food Restaurant	0.11
2	Bar	0.11
3	Greek Restaurant	0.05
4	Taverna	0.05
5	Coffee Shop	0.05
6	Botanical Garden	0.05
7	Beer Bar	0.05
8	Bougatsa Shop	0.05
9	Mobile Phone Shop	0.05

---- Terpsithea has 32 venues and a population of 4751 ----

	venue	freq
0	Café	0.16
1	Greek Restaurant	0.16
2	Bus Stop	0.06
3	Bar	0.06
4	Souvlaki Shop	0.06
5	Supermarket	0.06
6	Pizza Place	0.06
7	Gym	0.03
8	Gym / Fitness Center	0.03
9	Clothing Store	0.03

---- Thermi has 27 venues and a population of 53201 ----

	venue	freq
0	Coffee Shop	0.11
1	Souvlaki Shop	0.07
2	Taverna	0.07
3	Bakery	0.07
4	Donut Shop	0.04
5	Dessert Shop	0.04
6	Electronics Store	0.04
7	Clothing Store	0.04

8	Cocktail Bar	0.04
9	Plaza	0.04

---- Triandria has 15 venues and a population of 28210 ----

	venue	freq
0	Bougatsa Shop	0.07
1	Fast Food Restaurant	0.07
2	Ouzeri	0.07
3	Mobile Phone Shop	0.07
4	Bar	0.07
5	Bakery	0.07
6	Café	0.07
7	Fried Chicken Joint	0.07
8	Pizza Place	0.07
9	Gym	0.07

---- Troada has 11 venues and a population of 4781 ----

	venue	freq
0	Dessert Shop	0.09
1	Plaza	0.09
2	Supermarket	0.09
3	Bougatsa Shop	0.09
4	Souvlaki Shop	0.09
5	Video Store	0.09
6	Ouzeri	0.09
7	Gym	0.09
8	Café	0.09
9	Snack Place	0.09

---- Vardaris has 19 venues and a population of 14023 ----

	venue	freq
0	Restaurant	0.16
1	Cocktail Bar	0.11

2	Greek Restaurant	0.11
3	Hotel	0.11
4	Bistro	0.05
5	Modern Greek Restaurant	0.05
6	Tsipouro Restaurant	0.05
7	Bar	0.05
8	Bakery	0.05
9	Bougatsa Shop	0.05

---- Varna has 12 venues and a population of 4344 ----

	venue	freq
0	Greek Restaurant	0.17
1	Restaurant	0.08
2	Basketball Court	0.08
3	Pizza Place	0.08
4	Scenic Lookout	0.08
5	Café	0.08
6	Gym	0.08
7	Theater	0.08
8	Beer Bar	0.08
9	Supermarket	0.08

---- Votsi has 30 venues and a population of 11105 ----

	venue	freq
0	Supermarket	0.13
1	Coffee Shop	0.13
2	Bakery	0.13
3	Gym / Fitness Center	0.07
4	Fast Food Restaurant	0.07
5	Snack Place	0.07
6	Kafenio	0.03
7	Mobile Phone Shop	0.03
8	Bus Stop	0.03
9	Café	0.03

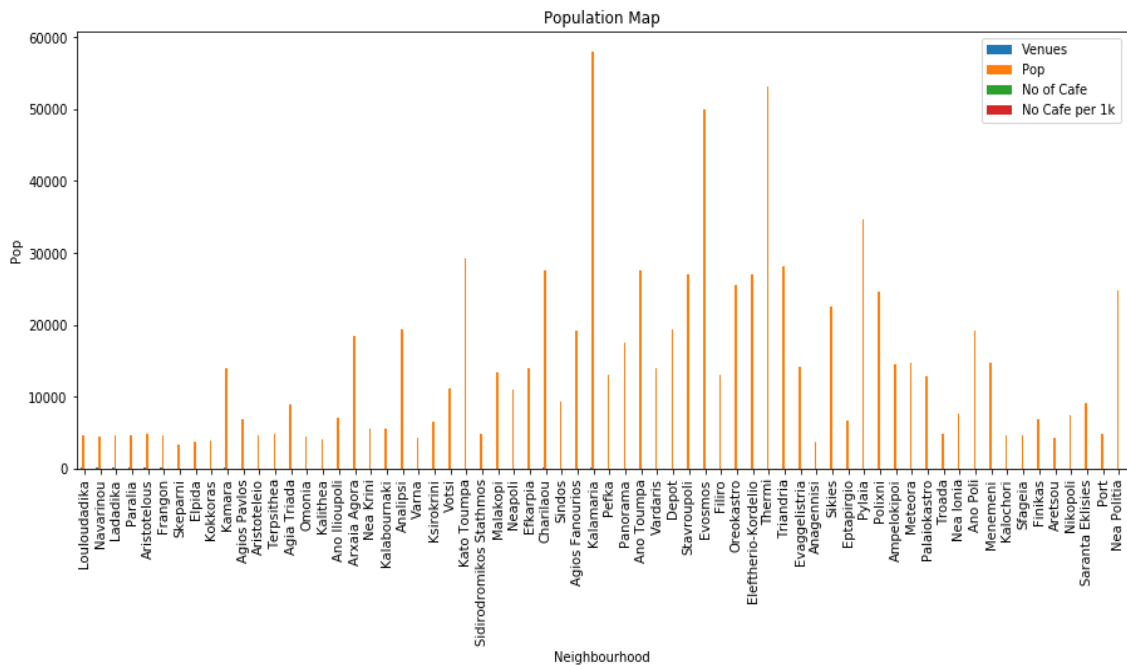
Neighbourhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Agia Triada	Café	Coffee Shop	Greek Restaurant	Hotel
1	Agios Fanourios	Greek Restaurant	Meze Restaurant	Café	Coffee Shop
2	Agios Pavlos	Café	Greek Restaurant	Castle	Bar
3	Ampelokipoi	Café	Greek Restaurant	Supermarket	Bar
4	Anagennisi	Mobile Phone Shop	Café	Dessert Shop	Plaza

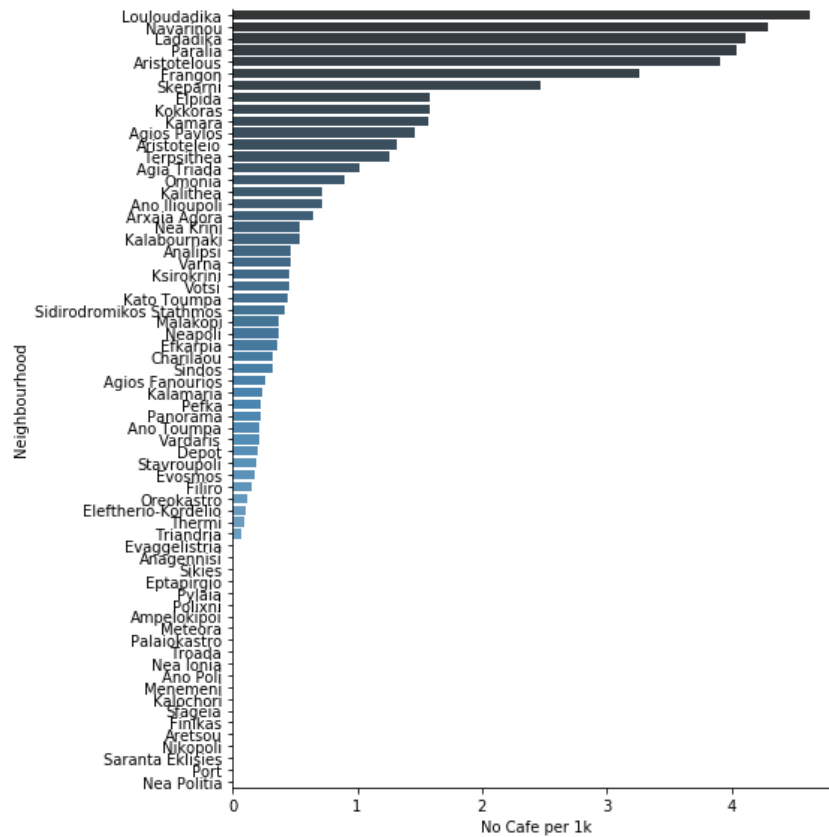
Besides the most frequent venues in each area, it's important to consider also the population living in the area.

One of the biggest drawbacks is the assumption that each population will visit solely the venues of their area.

In those areas where either there is no Foursquare listed Cafe, the value -NaN- will be replaced with 0.

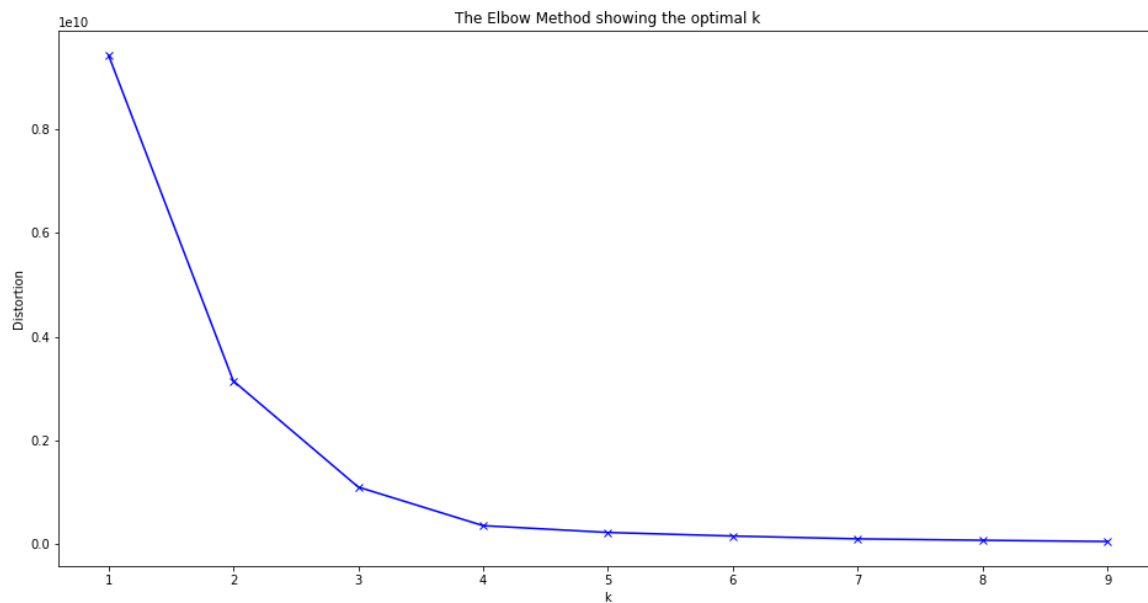
Visualization is a great tool to extract precious outcomes in a concentrated form. Two graphs are following: (1) The population map for each borough and (2) The number of cafes per 1,000 inhabitants.





Clustering is also important as I want to group the neighborhoods according to their characteristics.

The elbow method shows the optimal k for the clustering.



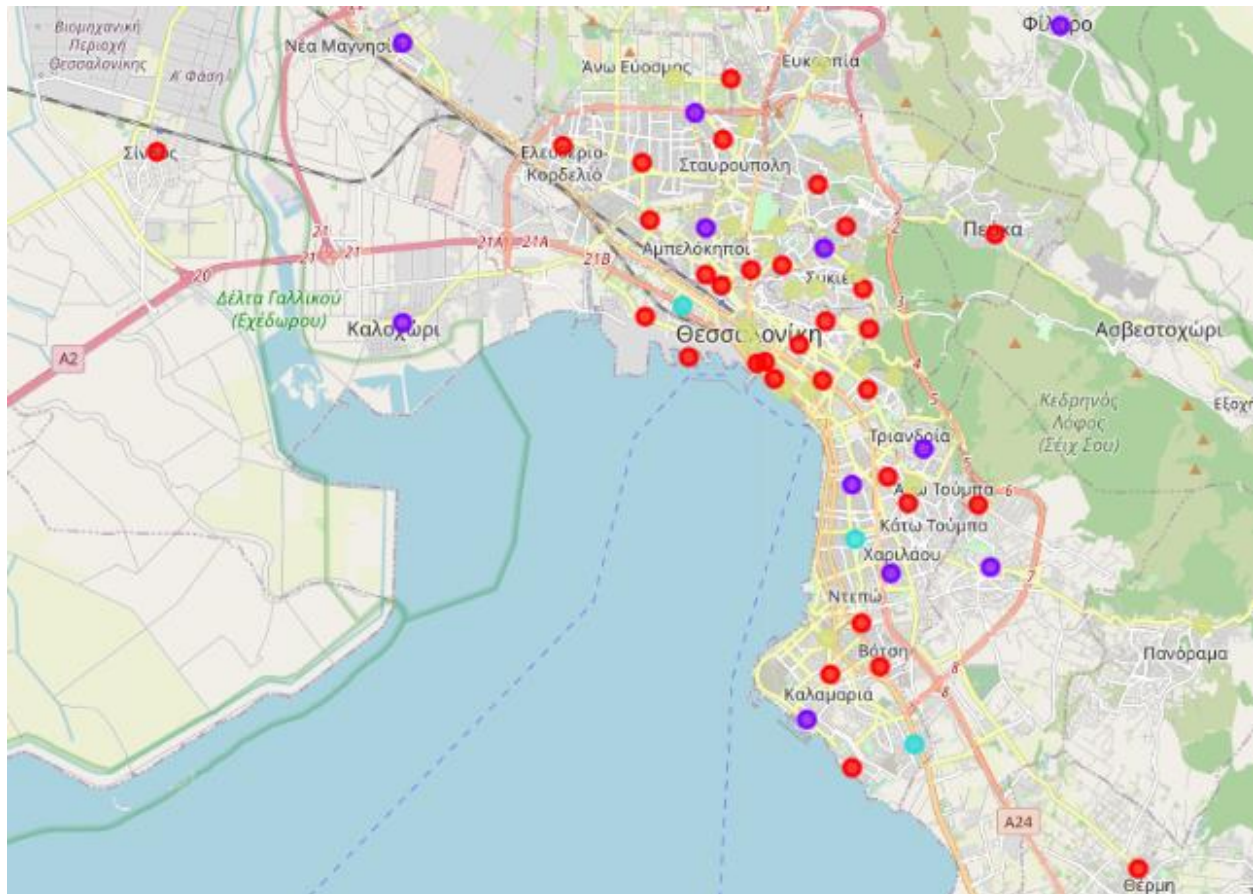


The main table has been transformed including the cluster category, the population, the number of venues and the cafes, and the latitude along with the longitude.

Neighbourhood	Cluster labels	Venues	Pop	No of Cafe	No Cafe per 1k	Latitude	Longitude
Louloudadika	0	100	4539	21.0	4.626570	40.635217	22.938601
Navarinou	4	85	4421	19.0	4.297670	40.630700	22.948700
Ladadika	0	100	4626	19.0	4.107220	40.635000	22.937000
Paralia	2	86	4708	19.0	4.035684	40.630518	22.942848
Aristotelous	0	100	4855	19.0	3.913491	40.632380	22.940940

### 3.Results

Having formulated the tables, it is important to illustrate the clusters on the map.



It is crucial to have all clusters listed in order to continue with the location research. The clusters are presented below, starting from the most promising places to open a cafe, continuing in descending order.

The formulated clusters are presented below:

Cluster No1

	Cluster labels	Neighbourhood	Venues	Pop	No of Cafe	No Cafe per 1k	Latitude	Longitude
0	0	Louloudadika	100	4539	21.0	4.626570	40.635217	22.938601
2	0	Ladadika	100	4626	19.0	4.107220	40.635000	22.937000
4	0	Aristotelous	100	4855	19.0	3.913491	40.632380	22.940940
6	0	Skeparni	30	3245	8.0	2.465331	40.649991	22.925824
9	0	Kamara	97	13993	22.0	1.572215	40.632139	22.951532
10	0	Agios Pavlos	39	6852	10.0	1.459428	40.640886	22.961603
11	0	Aristoteleio	22	4550	6.0	1.318681	40.630613	22.961326
17	0	Arxaia Agora	55	18486	12.0	0.649140	40.638083	22.946455
18	0	Nea Krini	15	5552	3.0	0.540346	40.567308	22.958035
22	0	Ksirokrini	21	6536	3.0	0.458996	40.648192	22.929279
23	0	Votsi	30	11105	5.0	0.450248	40.584234	22.964129
24	0	Kato Toumpa	49	29192	13.0	0.445327	40.611571	22.970410
26	0	Malakopi	29	13483	5.0	0.370837	40.611463	22.985956
27	0	Neapoli	33	10957	4.0	0.365063	40.651552	22.942708
30	0	Sindos	16	9289	3.0	0.322963	40.670536	22.804609
31	0	Agios Fanourios	38	19096	5.0	0.261835	40.615980	22.965811
32	0	Kalamaria	66	57964	14.0	0.241529	40.583058	22.953191
33	0	Pefka	20	13052	3.0	0.229850	40.656680	22.989744
37	0	Depot	28	19302	4.0	0.207232	40.591570	22.960169
38	0	Stavroupoli	19	27084	5.0	0.184611	40.672539	22.929546
39	0	Evosmos	50	49902	9.0	0.180353	40.668639	22.911515
42	0	Eleftherio-Kordelio	23	27067	3.0	0.110836	40.671410	22.894215
43	0	Thermi	27	53201	5.0	0.093983	40.550252	23.021072
47	0	Sikies	17	22544	0.0	0.000000	40.647503	22.960524
50	0	Polixni	10	24545	0.0	0.000000	40.665133	22.950492
52	0	Meteora	14	14787	0.0	0.000000	40.657906	22.956672
53	0	Palaiokastro	4	12772	0.0	0.000000	40.723242	22.906338
54	0	Troada	11	4781	0.0	0.000000	40.650771	22.935734
56	0	Ano Poli	36	19154	0.0	0.000000	40.642000	22.952000
57	0	Menemeni	8	14746	0.0	0.000000	40.659111	22.913238
59	0	Sfageia	20	4583	0.0	0.000000	40.642797	22.912476
62	0	Nikopoli	4	7452	0.0	0.000000	40.682636	22.931380
64	0	Port	1	4747	0.0	0.000000	40.636000	22.922000

Cluster No2

Cluster labels	Neighbourhood	Venues	Pop	No of Cafe	No Cafe per 1k	Latitude	Longitude	
8	1	Kokkoras	23	3807	6.0	1.576044	40.654466	22.951838
13	1	Agia Triada	43	8861	9.0	1.015687	40.614639	22.957900
16	1	Ano Ilioupoli	18	6994	5.0	0.714898	40.676974	22.923420
29	1	Charilaou	58	27623	9.0	0.325815	40.600000	22.986667
40	1	Filiro	7	13052	2.0	0.153233	40.691547	23.003896
44	1	Triandria	15	28210	2.0	0.070897	40.620717	22.973854
49	1	Pylaia	15	34625	0.0	0.000000	40.600941	22.988687
51	1	Ampelokipoi	42	14532	0.0	0.000000	40.657817	22.925769
55	1	Nea Ionia	12	7576	0.0	0.000000	40.688825	22.858903
58	1	Kalochori	6	4672	0.0	0.000000	40.641963	22.858805
61	1	Aretsou	49	4164	0.0	0.000000	40.575364	22.947923

### Cluster No3

Cluster labels		Neighbourhood	Venues	Pop	No of Cafe	No Cafe per 1k	Latitude	Longitude
20	2	Analipsi	38	19459	9.0	0.462511	40.605500	22.958812
25	2	Sidirodromikos Stathmos	42	4780	2.0	0.418410	40.644588	22.920662
60	2	Finikas	19	6941	0.0	0.000000	40.571090	22.971795

### Cluster No4

Cluster labels	Neighbourhood	Venues	Pop	No of Cafe	No Cafe per 1k	Latitude	Longitude	
1	3	Navarinou	85	4421	19.0	4.297670	40.630700	22.948700
3	3	Paralia	86	4708	19.0	4.035684	40.630518	22.942848
5	3	Frangon	70	4594	15.0	3.265128	40.638348	22.935515
7	3	Elpida	36	3783	6.0	1.586043	40.658080	22.941657
12	3	Terpsithea	32	4751	6.0	1.262892	40.658293	22.931714
14	3	Omonia	21	4478	4.0	0.893256	40.674313	22.934771
15	3	Kalithea	14	4155	3.0	0.722022	40.647206	22.944919
19	3	Kalabournaki	34	5553	3.0	0.540249	40.588865	22.952594
21	3	Varna	12	4344	2.0	0.460405	40.647662	22.949993
28	3	Efkarpia	16	13905	5.0	0.359583	40.684681	22.950997
34	3	Panorama	31	17444	4.0	0.229305	40.591225	23.035181
35	3	Ano Toumpa	38	27613	6.0	0.217289	40.614813	22.971397
36	3	Vardaris	19	14023	3.0	0.213934	40.641073	22.935001
41	3	Oreokastro	11	25545	3.0	0.117440	40.723575	22.924373
45	3	Evaggelistria	24	14120	0.0	0.000000	40.634814	22.959953
46	3	Anagennisi	21	3756	0.0	0.000000	40.654116	22.939157
48	3	Eptapirgio	18	6710	0.0	0.000000	40.650108	22.958651
63	3	Saranta Eklisies	17	9178	0.0	0.000000	40.632620	22.967200
65	3	Nea Politia	2	24784	0.0	0.000000	40.682753	22.918720

## 4. Discussion

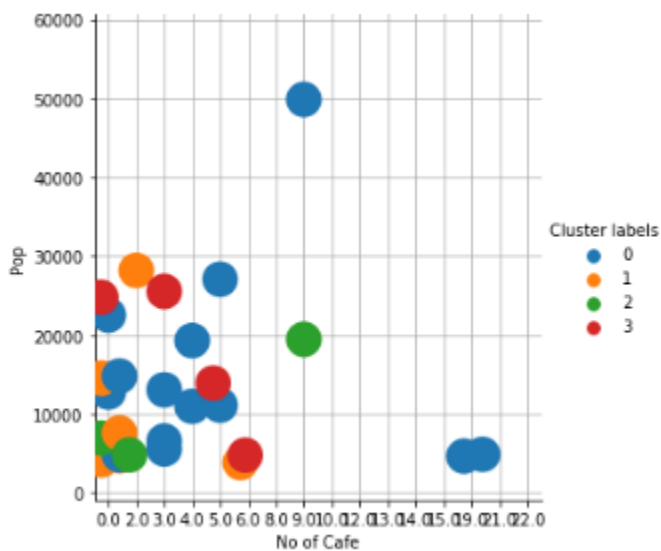
As mentioned earlier, Thessaloniki is a big city with highly populated center and less populated peripheral zones. Using the elbow method to calculate the optimal amount of clusters and having considered the number of venues in the area (within 500m proximity to each venue), the number of cafes in the area I generated an approximate depiction of the areas where the investors of a new cafe should focus on.

I used the Kmeans algorithm as part of this clustering study. When I tested the Elbow method, I set the optimum k value to 4. For the clustering process I considered the coordinates of each borough, the total venues in that area and the number of cafes.

I ended the study by visualizing the data and clustering information on two different maps. The first shows the total inhabitants in each borough and the second the number of cafes per 1.000 inh..

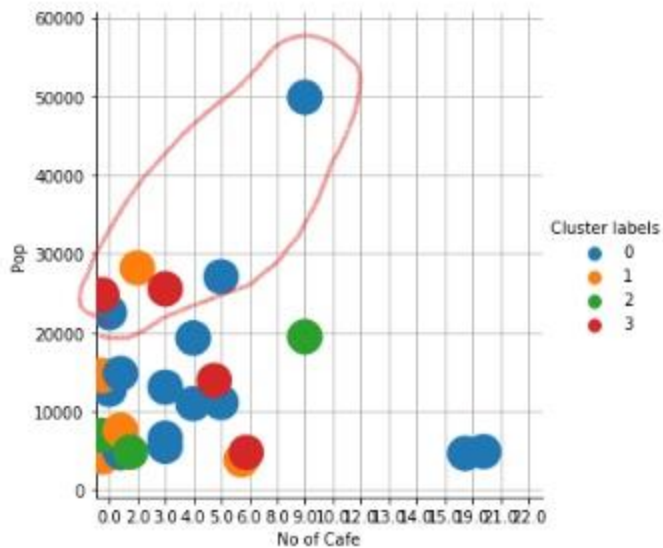
However, there are some limitations in this research. Namely, the fact that the database uses only information from the Foursquare registered venues, which excludes all shops which do not have any partnership with the platform. Secondly, the assumption that each location has potential customers account to the total population of each borough. The problem specifically lies on the population which live on the "boarders" of each borough and those who may choose a coffee shop from another neighboring area. Additionally, this research does not consider all city centers, malls, areas with parking areas in proximity, or free time/activity designated areas which will attract more potential customers. Finally the total costs of running a business, the rents, the attractiveness of each location are important factors for the location selection.

In the cell below, the graph illustrates the population of each borough to the number of cafes in the area.



## 5. Conclusion

From the above graph, I can conclude that the majority of the clusters are performing well, balancing the population and the cafe options. I would clearly go to the top blue outlier, an area of 50,000 people who are under served. The rest of the upper left corner are looking promising as well.



On the contrary, I wouldn't select the two far right outliers, as it seems that they are less crowded, though are adequately covered with coffee shops. For the same reasons I would exclude the boroughs in the red circle.

