Drone Shipping Facility

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1. İntroduction:

1.1. Background and Problem:

With the emergence of Covid-19, we had to make many changes in for our lifestyle habits. The most important of these is our habit of shopping. Researches shows that internet shopping has increased significantly after Covid-19. People even make their daily grocery shopping online. In fact, if you look carefully, this situation offers us a new business area. A shipping company..

However, it cannot be an ordinary shipping company. Because customers do not want physical contact with the couriers. The solution for this is of course in technology ..

We can find a perfect solution to this problem by using drones which we have encountered in all areas of our lives lately. Also, with the idea of "drone courier", we can easily attract people's attention to this issue.

So, as an indigent entrepreneur, first we need an investor. Throughout this study We presume that we have an investor, and he/she has made a deal with Turkey's one of the biggest market chain "BİM". Our story continues like this:

Therefore, we find that an investor and we decided to open one facility for a trial period. If we will be successful, investor will increase his/her investments. So, We need to find the most suitable location for this facility. In a meeting we held with our team and determined our preliminary needs as follows:

- We have 2 methods for our courier drones work cycle. The first one is to reach an agreement with local markets and take over the cargo transactions which currently operated by human couriers. The second method is to establish our own material warehouse and to manage the transportation business from this warehouse. Although the second option seems more reasonable, we need to focus on the first option, since we do not have enough budget for this start-up.

- In line with the news we received from our investor, we learned that agreements were made with "BIM" chain markets, which are widely available in our country. In this context, it is important that we choose the region where these markets are found at the highest number.

- Another goal of ours is to establish the infrastructure for the use of our drones in individual trade, in addition to the service to be provided to the BİM markets. Thus, the cargo drone will be able to take the material from the balcony or window of the house of the person selling and deliver it to the customer from the balcony or window of his house in a very short time.

Drones consume approximately 2 times more fuel when carrying cargo due to their cargo weight, so first of all, we need to travel the least with our drones loaded. In this context, we have collected the features of the most suitable location for the facility under the following headings:

- The region where "BİM" is most concentrated,
- For personal use, the region with high population ratio

should be preferred.

1.2. Interest:

Obviously, any investor may interest a topic like this. Because future force us to develop technology. Whoever takes the first step he/she always be one step ahead from the others.

2. Data acquisition and cleaning

2.1. Data sources:

- İstanbul Borough names and population from here,
- Borough coordinates from “geopy” library,
- BİM market’s coordinates from FORSQUARE api.

2.2. Data Cleaning

Since the data I use is generally based on coordinate and address information, it was’t required to use lots of data cleaning methods. Only;

- In the BIM query which I made from the FORSQUARE api, I corrected the "i" characters except for UTF-8.
- In my review, I saw that the addresses of the other places also contains the word “bim” were included in my query (for example: bimex, bi mola etc.) and I have dropped these lines.
- And the only fix I made apart from these was to combine the relevant data sets to create a data frame that I will use in the ML model.

3. Metedology:

3.1. Exploratory Data Analysis:

First, I plotted the İstanbul district names and population amounts by using the folium library with the first two data sources I mentioned in article 2.1.

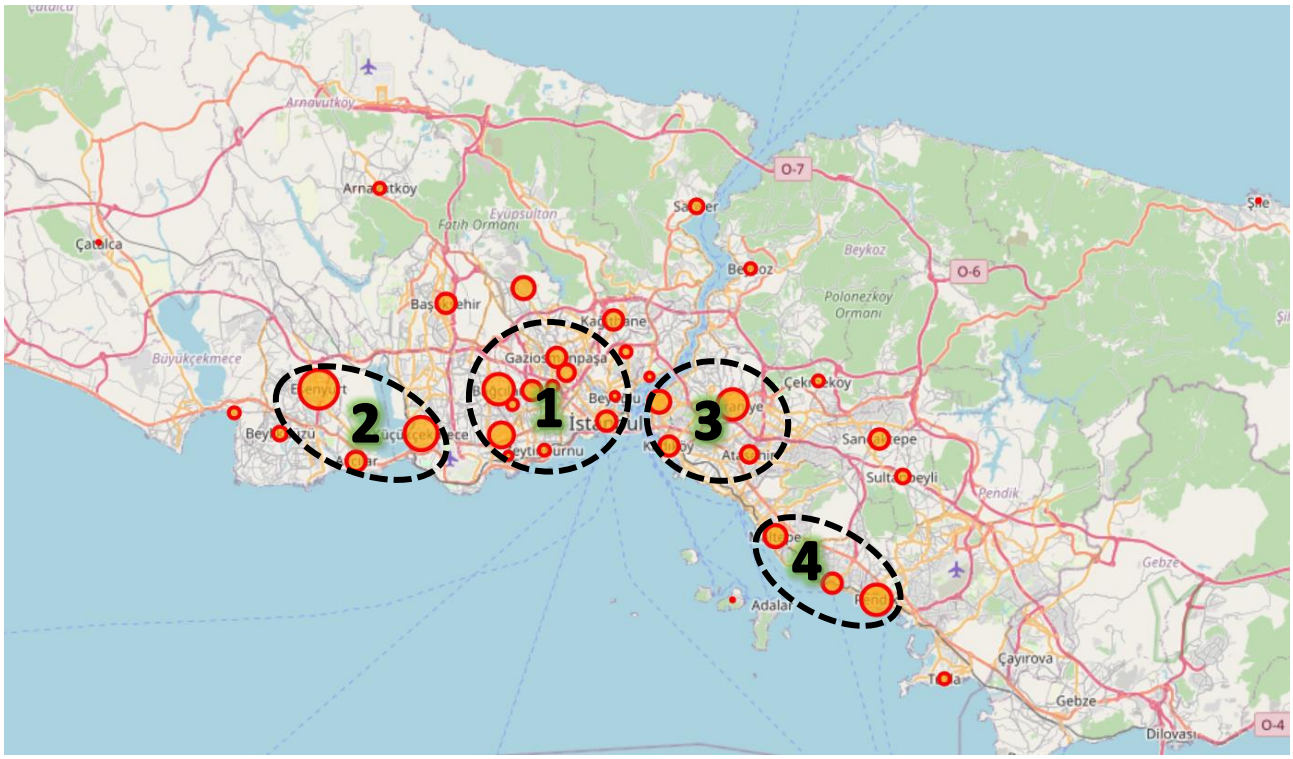

Figure-1: Borough centers of Istanbul and the amount of population

Here, I made the first outcome by evaluating the size of the district centers as a coefficient of the population density. This plotting provided important information on where the facility could be established.

Later, I found the positions of BIM markets using the FORSQUARE API and plotted them using the folium library.

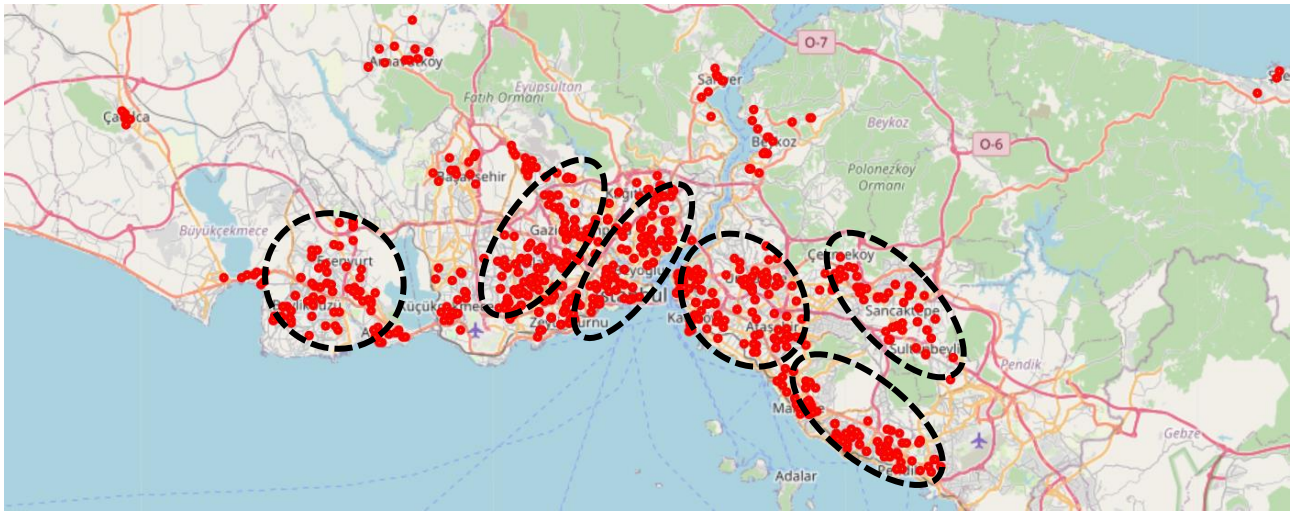

Figure-2 BİM markets in Istanbul (FORSQUARE api)

With this plotting, I noticed that the result in Figure-1 gained more detail. In this case, what I had to do was wait for ML methods to help me choose.

3.2. Model Selection:

Although K-Means was used for the model selection in the example shown in the course, I did not want to choose this model because the number of clusters should be specified in this.

I wanted the number of clusters were cohosen bu ML model so I preferred the DBSCAN algorithm and a total of 14 clusters came out. This was a result that met my expectation.

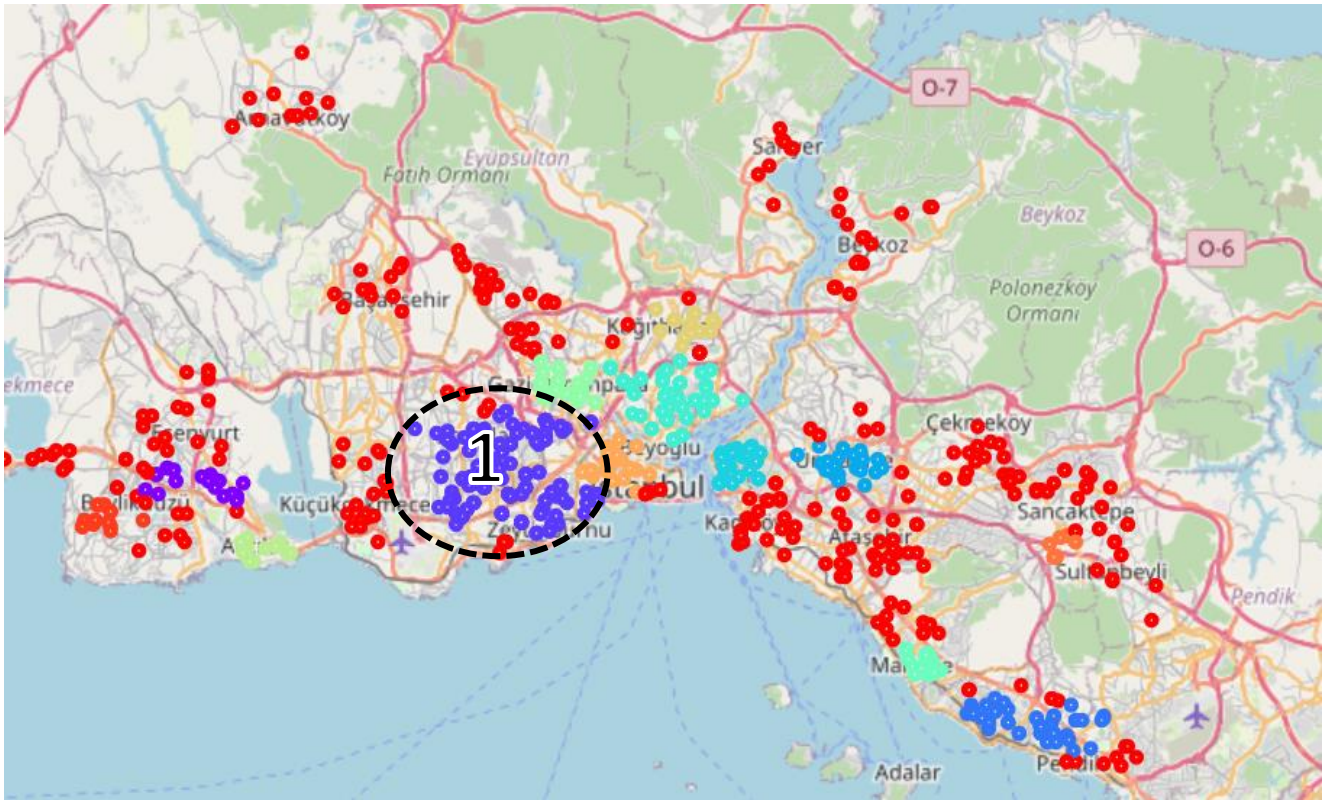

Figure-3: Cluster Results

4. Results and Discussion :

4.1. Results:

The result of the modeling yielded 14 clusters and it was observed that Cluster-1 has the best possibility. A total of 189 markets from 10 boroughs were preferred in Cluster-1. The boroughs and the number of markets included in the result are as follows:

Borough	cluster_labels
Bahçelievler	27
Bakırköy	26
Bayrampaşa	16
Bağcılar	26
Esenler	23
Eyüpsultan	6
Fatih	2
Gaziosmanpaşa	5
Güngören	30
Zeytinburnu	28

Figure-4: Boroughs and the market number in Cluster-1

4.2. Discussion:

While working with the model, I had to make some manual trials in order to adjust the parameters (eps and min_samples) precisely.

In [25]:
```
#Construct Model
'''
min samples should be 12
eps : in radius 0.12
'''

model = DBSCAN(eps=0.12, min_samples =12, metric='euclidean').fit(dbscan_data)
cluster_numbers = Counter(model.labels_)
cluster_numbers
```

Out[25]:
```
Counter({-1: 324,
         0: 25,
         1: 189,
         2: 45,
         3: 22,
         4: 45,
         5: 78,
         6: 18,
         7: 53,
         8: 12,
         9: 21,
         10: 39,
         11: 13,
         12: 18})
```

Figure-5: Model Parameters

If the study is expanded a little more, it will be beneficial to automatically test the parameters and test with the other unsupervised methods to determine which one will give the best result by using other models.

5. Conclusion and Future Directions:

5.1. Conclusion

Last several months, internet shopping is becoming more widespread due to Covid-19 and for people to stay away from each other. In this study, I examined where the Drone Shipping Facility, which offers a solution for this, should be located within the borders of Istanbul.

I used the DBSCAN ML model in my solution and I was satisfied with the results. Although it might thought that smoother results can be obtained by reproducing and diversifying the data in data frame, I think that the result will be similar to the result of this study.

5.2. Future Directions

I think we will see drone couriers frequently in the near future. In addition to commercial couriers, it can also be used by governments to carry out health checks and meet the needs of older people without leaving their homes.

In order to complete the work, there are also software needs such as 3D distance determination via their phones, as well as face recognition or ID card reading systems in order to make a good R&D for distance and fuel needs of drones and to find and determine the person to whom the coargo will be delivered.