IBM APPLIED DATA SCIENCE CAPSTONE

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Classification of Delhi Metro stations

Introduction

Delhi Metro is a rapid transit system serving Delhi and its satellite cities in the National Capital Region of India. As of now, there are a total of 229 metro stations including the Airport Express stations. The first section of the Delhi Metro opened on 25 December 2002 with the Red Line, and has since been expanded to around 347.66 km (216.03 miles) of route length as of 4 October 2019. The network has nine operational lines and is built and operated by the Delhi Metro Rail Corporation Limited (DMRC). The Delhi Metro Rail Corporation makes 2,700 trips per day carrying 1.5 million passengers, who on an average travel a distance of 17 kilometres each.

For this project, we will try to look at the places surrounding these metro stations and classify them according to the similarity of nearby venues. Almost every one use metro transit to migrate from one place to another for reasons which can be personal of professional. If there are more professional places like companies, offices surrounding a station then it will mostly be used by working professionals. Then there are some stations with many universities or colleges nearby and is used by Students mostly. Stations which have places like amusement parks, malls, monuments are used by people for recreation.

We can classify stations by primary usage analysing the data that contains the number of nearby venues according to their category. This can help plan further extension of the network and find places for new development.

Data

In this section we will describe our base data which we will analyse to reach the goal we want.

We will be requiring some Python libraries and modules like Pandas, Numpy, JSON, requests, geopy, bs4, sklearn, etc.to move further in the project.
The main source of stations data that will contain the list of all the metro stations under DMRC in Delhi. Is the following Wikipedia page.

https://en.wikipedia.org/wiki/List_of_Delhi_Metro_stations

We have to scrape the relevant table data from this url like Station name, Line.

To get the latitude and longitude values we will use geopy.geocoder module and will geocode each station.

Assumption :-

- There are some stations with more than one line that pass through it. So we have assumed that only the line that is written first on the above url will be the data of our choice to nullify the ambiguity that we may face while plotting on the graph

To get the nearby venues of all stations we will be using Foursquare API for which we need to create an account on the following url.

https://developer.foursquare.com/.

After this we will be required to pre-process data and create a data frame. After the pre-processing our data will look something like this.

	Station	Line	Latitude	Longitude
0	Adarsh Nagar	1	28.714401	77.167288
46	Ghitorni	1	28.493751	77.149187
81	Jor Bagh	1	28.588239	77.216528
134	New Delhi	1	28.643641	77.221737
68	Jahangirpuri	1	28.725972	77.162658

Methodology:-

We have the the data related to the metro station under DMRC, their latitudes and longitudes values with the line of Metro that passed through them.

For further processing we will be utilizing the **FOURSQUARE API** and explore the venues in a specific radius around that using their coordinates values.

We will use explore query under venues of the api calls. You can read more about the various Endpoints provided Foursquare api on the following link. **https://developer.foursquare.com/docs/places-api/endpoints/**

The advantage of using Foursquare api is that venues are classiied in particular categories which will make it easy to calculate the number of venues surround a given location for each category and that is actually the base of our classification.

- Arts & Entertainment (4d4b7104d754a06370d81259)
- College & University (4d4b7105d754a06372d81259)
- Event (4d4b7105d754a06373d81259)
- Food (4d4b7105d754a06374d81259)
- Nightlife Spot (4d4b7105d754a06376d81259)
- Outdoors & Recreation (4d4b7105d754a06377d81259)
- Professional & Other Places (4d4b7105d754a06375d81259)
- Residence (4e67e38e036454776db1fb3a)
- Shop & Service (4d4b7105d754a06378d81259)
- Travel & Transport (4d4b7105d754a06379d81259)

We'll be querying the number of venues in each category in a 1000m radius around each station. This radius was chosen because 1000m is a reasonable walking distance.

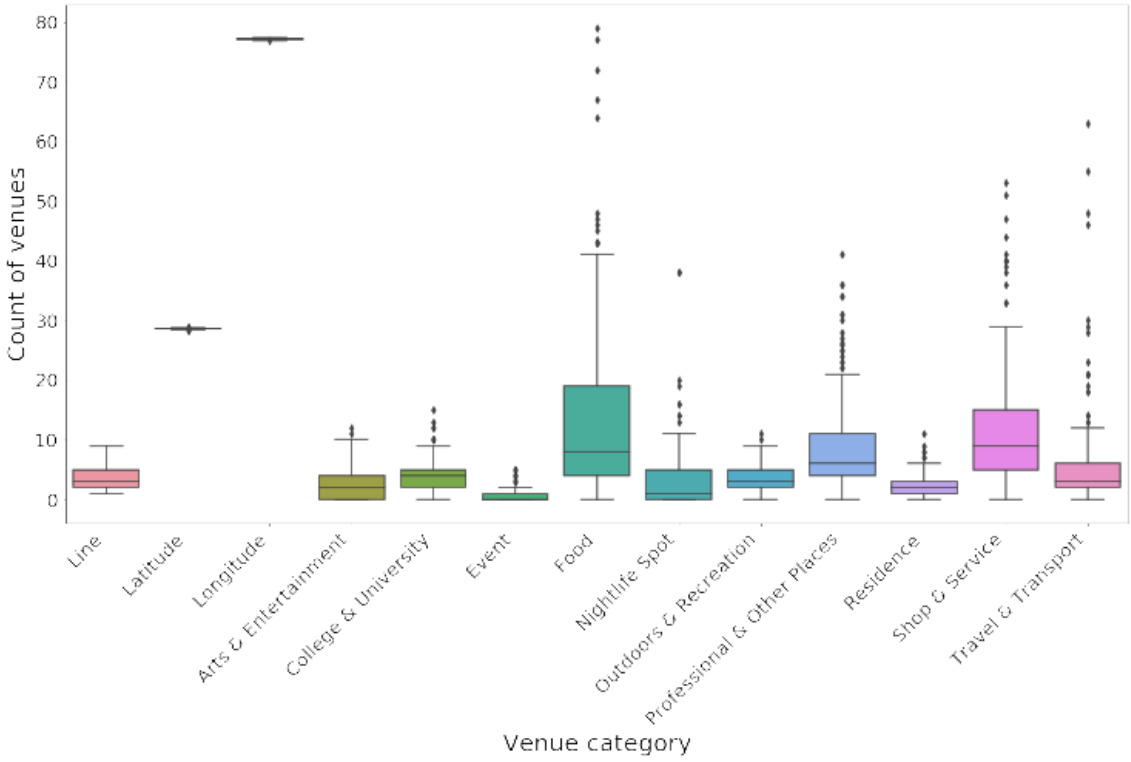
explore_url = 'https://api.foursquare.com/v2/venues/explore?client_id={}&client_secret={}&v={}&ll={},{}&radius={}&categoryId={}'.format(CLIENT_ID, CLIENT_SECRET, VERSION, lat, long, radius, categoryId)

After the above procedure, our data-frame will look something like this.

	Station	Line	Latitude	Longitude	Arts & Entertainment	College & University	Event	Food	Nightlife Spot	Outdoors & Recreation
0	Adarsh Nagar	1	28.714401	77.167288	1	1	0	8	1	1
1	Ghitorni	1	28.493751	77.149187	2	1	0	5	1	3
2	Jor Bagh	1	28.588239	77.216528	3	2	2	17	2	3
3	New Delhi	1	28.643642	77.221737	2	5	2	36	9	1
4	Jahangirpuri	1	28.725972	77.162658	0	1	0	2	0	1

Visualization and Modeling

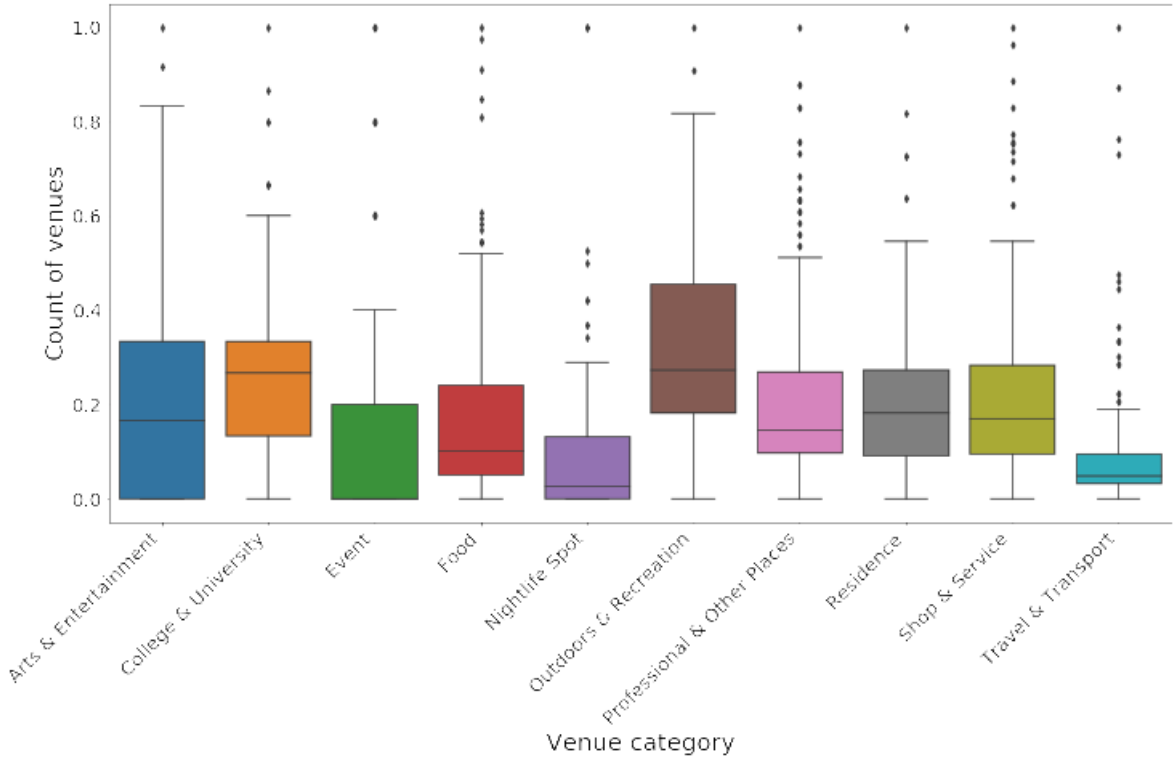
Using a Box Plot to see the the distrubution of venue count for each category.



Ignoring the Latitude and Longitude and analysing the categories distribution we can see that most of the venues are in the category of Food, Professional places and Shops & Services. While others are comparitively less in number.

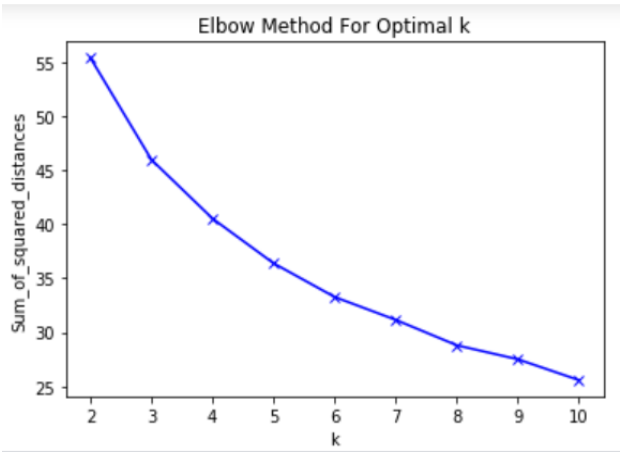
To make a good visualization let us Normalize the data so that every cell value will be in between 1 and 0 using the MinMaxScaler and removing the Latitude and longitude column through slicing.

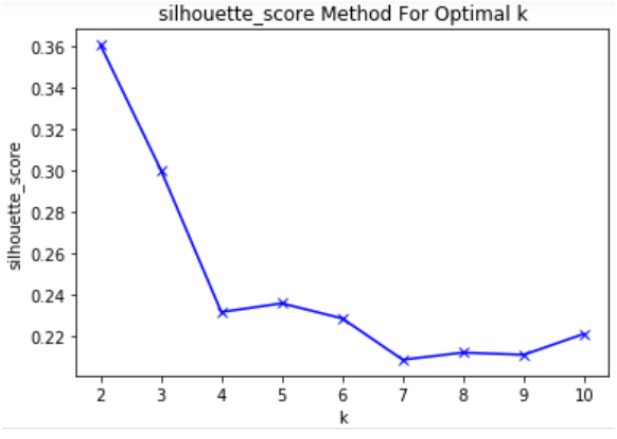
Data Normalization



Clustering:-

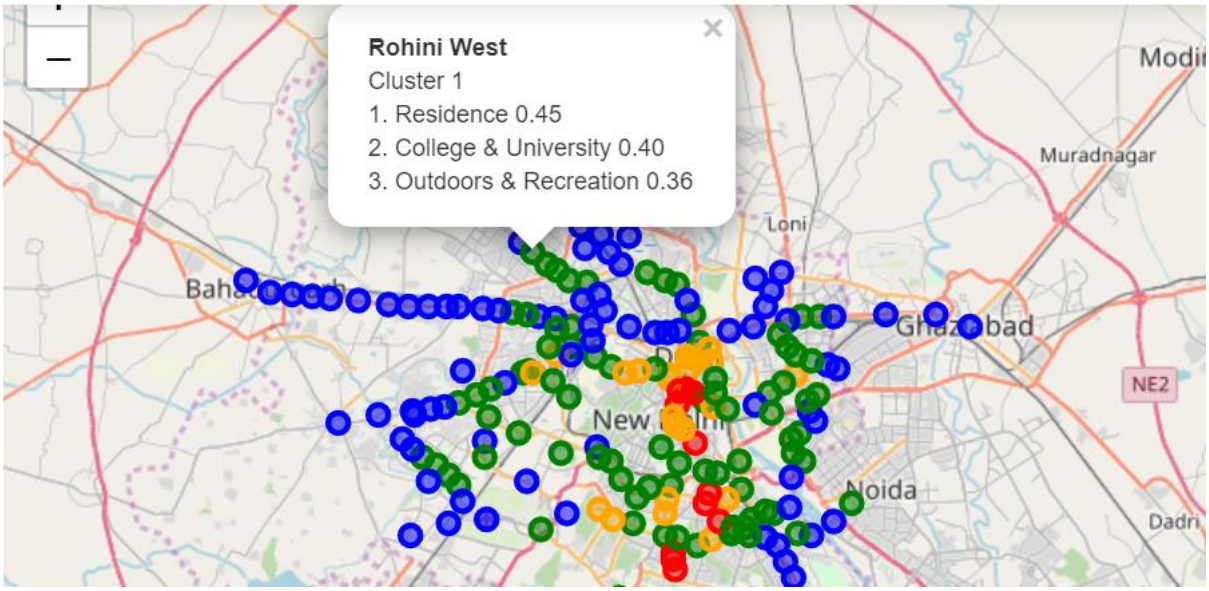
So we have the data and using an unsupervised clustering Algorithm known as KMeans Clusteing we will Create clusters. To get started You may know that 'K' Means Numbers of clusters in which data is to be categorized. Now problem is we dont know how to evaluate the best K value so we will run the Kmeans algorithm on different values of K. Then we will use some measures or metrics to see which K value will be the most suitable.
First we will use the 'ELBOW METHOD' to check the most appropriate value of K.
Second we use the ‘Silhoutte Score Method’.





Clusters Visualization and Analysis

We cannot find a Global maxima or best K value In any of the method but we have a local maxima when the value of 4. So for our Clustering let us use K value as 4.



Results:-

Cluster 0 (Blue)

Data Analysis Shows that **Blue cluster/ Cluster 0** have high value in almost all the fields of College & University, Professional & Other Places, Outdoors & Recreation, Shops & Service and also in other categories for some stations.

1. From the map, if we compare it with the Line station map we see that almost every Station on Red line falls in this cluster.
2. Moreover, there are small patches in the North and South Delhi region where there are many colleges of Delhi university and other institutions.

Cluster 1 (Blue)

Data Analysis Shows that **Green cluster/ Cluster 1** have high value in almost all the fields of Residence, Professional & Other Places, Outdoors & Recreation, Arts & Entertainment , Shops & Services and College & University than other categories.

1. From the map, We see that stations like Jor Bagh, Civil Lines and many other places which are considered to be Posh or are Residential areas are in this cluster.
2. Talking about shops and services some Famous Market areas like Chandni Chowk, Sarojini Nagar etc. are present in this cluster.
3. Moreover, there are Many places of Recreation and outdoors like Hauz Khas, Chhatarpur, Kalkaji, Akshardham etc. are clustered in this cluster.

Cluster 2 (Yellow)

Data Analysis Shows that Yellow cluster/ Cluster 2 have high value in almost all the fields of Event, Residence, Outdoors & Recreation, Arts & Entertainment , Travel & Transport than other categories.

1. Analysis shows us that this cluster is geographically centered at almost central part of Delhi and including stations like Kashmere Gate, Welcome which have interchanges so mostly visited by people who travel alot and thats one of the reason there is more of Travel and Transport facility.
2. From the map, We see that there are important stations like AIIMS, Supreme Court in this cluster.
3. This actually shows that there is a need of continuous development in these areas.

Cluster 3 (RED)

Data Analysis Shows that Red cluster/ Cluster 3 have high value in almost all the fields of Event, Nightlife, Outdoors & Recreation, Professional & Other Places, College & University than other categories.

Analysis shows us that this cluster consists of industrial and professional places like Faridabad, some Noida sectors.

DISCUSSION:-

Note that Foursquare data isn't very precise and accurate. The Foursquare counts for the venues that we can explore via Foursquare data. This doesn't take into account other attributes that are essential and impotant to take while making clusters like Venue's size, services it provide, small shops or 'Rehdis' that are usually present almost everywhere. Moreover we do not take into account the Food while analysis as this is the attribute almost equal everywhere.

Also using Geocoder has some limitations in how accurate the geocoding of an address will be returned. There is also ambiguity with some places due to similar names or changes in names.

CONCLUSION

Foursquare data is limited but can provide insights into a city's development. This data could be combined with other sources to provide more accurate results.