The Developed and Under Developed Districts in Tamil Nadu

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1.Introduction

This project aims to find the Districts which are developed and underdeveloped in Tamil Nadu. With the help of Four Square Data, The venues in Different districts have been collected. The collected data contains venue category and also give the exact location of the venue. By using this data from Four Square we can do the exploratory analysis of data and group them based on their similarities. based on the venue data the districts have grouped by using a Machine Learning algorithm called K-means Algorithm. By finding the areas which are underdeveloped can help the persons who are trying to open venues in that particular District. And also by finding the areas which are developed can be used to get more insights about the district. We can know more about the district which are underdeveloped and it can give us enough information about the diffrent venues and based on that we can recommand a person to open a venue on that district.

1.1. Business Problem

In this project we can find the developed and underdeveloped areas in TamilNadu. this helps to establish a venue in a underdeveloped area so that we can get more profit there and at the same time we don't have competitors. and also by knowing the developed area we can get more insights about the area and it can give us the idea of what type of venue to open in that area.

1.2. Scope

1. The scope of this project is to create a clustering machine learning model which groups the districts based on there similarities.
2. This project use Datas from the Four Square which gives the information about a location.
3. This project groups the districts based on the venue data from from Four Square

2. Data acquisition and cleaning

2.1. Data Sources

2.1.1. List of Districts

The list of Districts were extracted from wikipedia https://en.wikipedia.org/wiki/List_of_districts_of_Tamil_Nadu this lists district and it also has additional information of the districts like area of the district, population density, capital of the district, diffrent Taluks in the district in the district, and Code of the district.

Example

District	Code	Area		Population	Taluks
Ariyalur	AR	1949		754,894	Ariyalur
Chengalpattu	CGL	2,944.96		2,556,244	Chengalpattu

here only the District name, District code and population are extracted.

2.1.2. Latitude and Longitude

The Latitude and Longitude of different district are provided by Python library called **GioPy**. By giving the code and name of the district we can get the Latitude and Longitude of the district. GioPy sometimes gives error during the process so we should be careful by using try-exec in python.

using **GioPy** Latitude and Longitude are extracted

Example

District	Code	Area	Population	Taluks	Latitude	Longitude
Ariyalur	AR	1949	754,894	Ariyalur	11.076036	79.117455
Chengalpattu	CGL	2,944.96	2,556,244	Chengalpattu	12.684089	79.983637

2.1.3. Four Square Data

Foursquare is a social location service that allows users to explore the world around them.The Foursquare API allows application developers to interact with the Foursquare platform. The API itself is a RESTful set of addresses to which you can send requests, so there's really nothing to download onto your server. We can explore the venues around us by difining the Latitude and Longitude. It gives the list of Venues. In this project we get the venues of different district and we use it to find similarity between the districts.

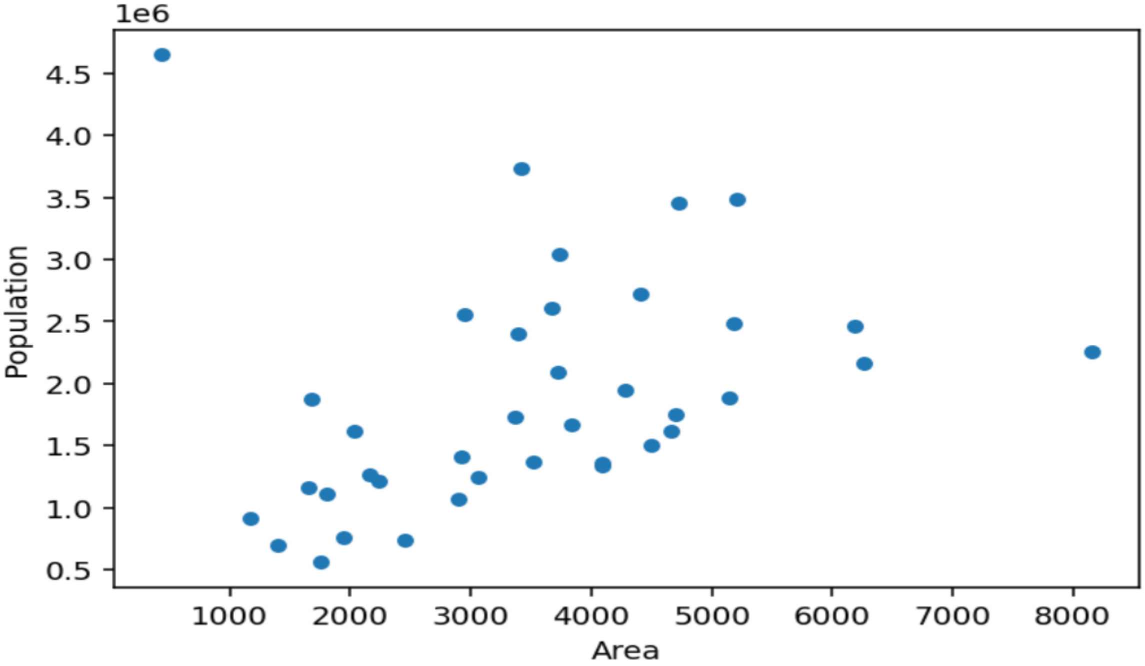
No	District	Latitude	Longitude	Venue	venue Latitude	Venue Longitude	Venue Category
0	Chengalpattu	12.684089	79.983637	SRK	12.698709	79.970428	Movie Theater
1	Chengalpattu	12.684089	79.983637	Latha Cinemas	12.680661	79.980511	Movie Theater
2	Chengalpattu	12.684089	79.983637	Changalpettu Bus Stand	12.692468	79.979310	Bus Station
3	Chengalpattu	12.684089	79.983637	Chengalpet To Beach Train	12.693512	79.981451	Light Rail Station
4	Chengalpattu	12.684089	79.983637	Kolavai Lake	12.710869	79.980555	Lake

2.2 Data Cleaning

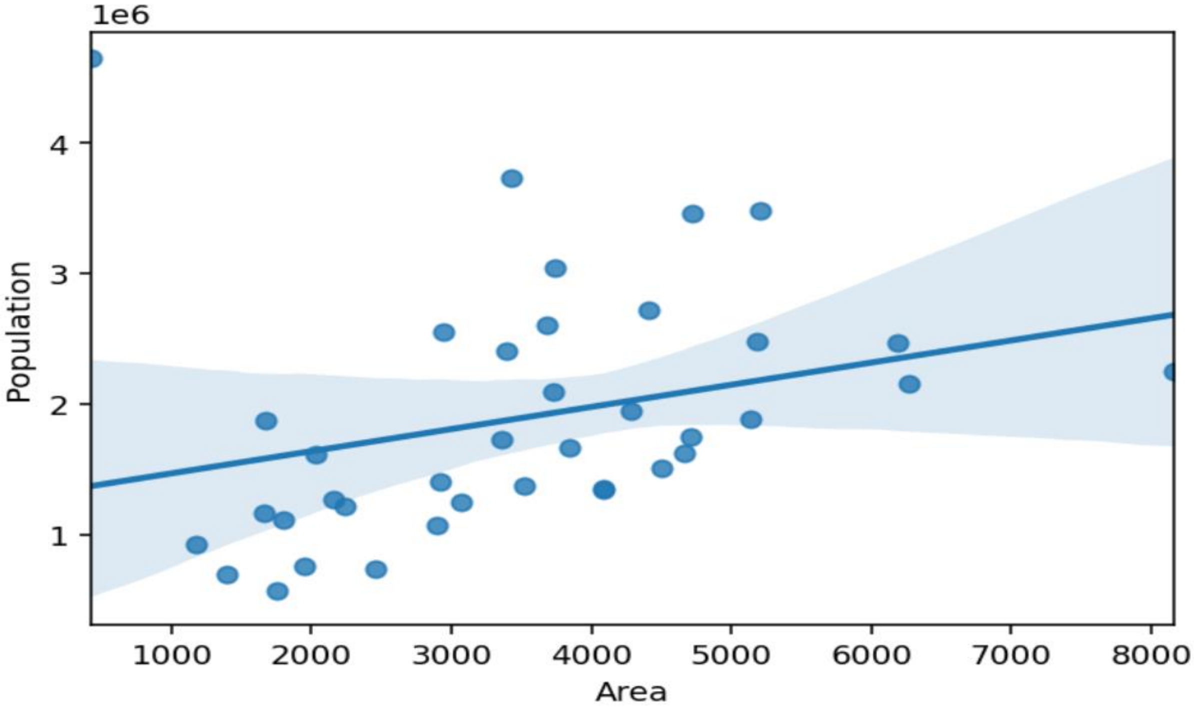
The Data from the wiki-pedia is scraped by using **pandas** library. The scraped data contains various tables. The table which contains the list of Districts is extracted and then converted into pandas **Data Frame**. only the Districts name, Code, population and area features are selected.

3. Exploratory Data Analysis

3.1. Relationship between Area and Population

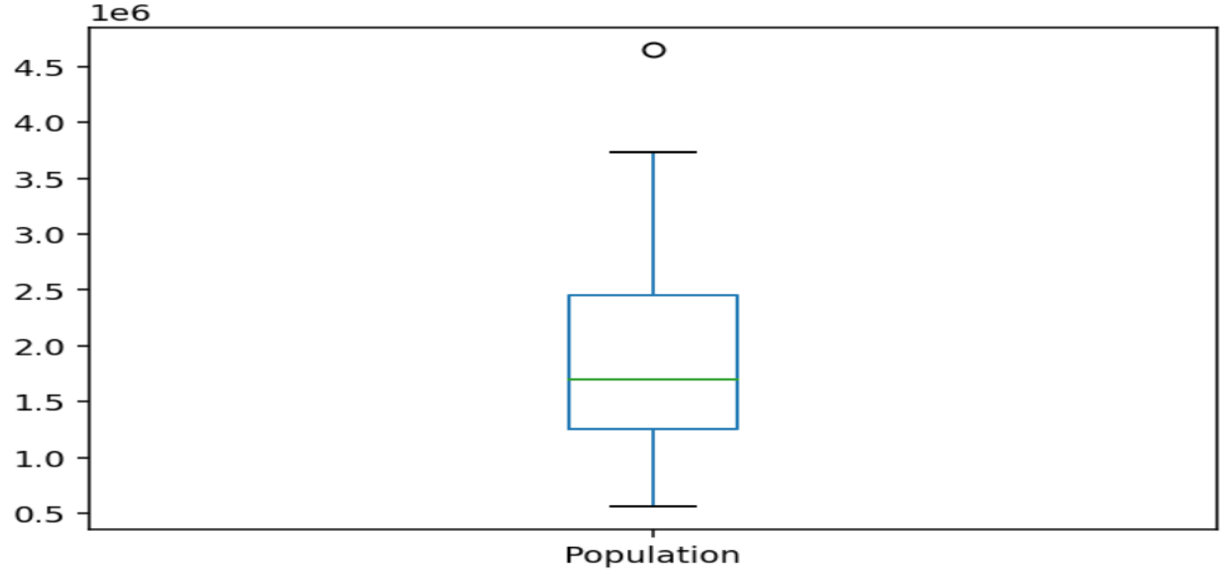


3.2. Regression between Area and Population

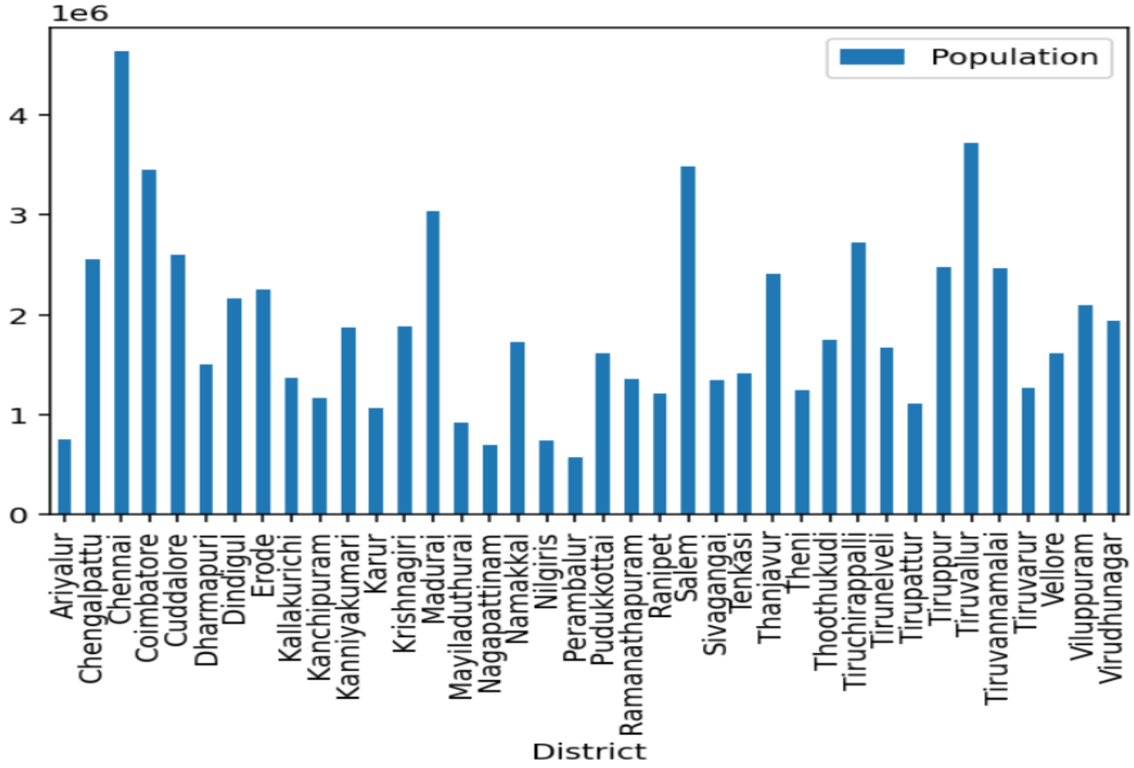


3.3. Population distribution

Box Plot to find the outliers



Bar Chart to find the distribution of Population between districts



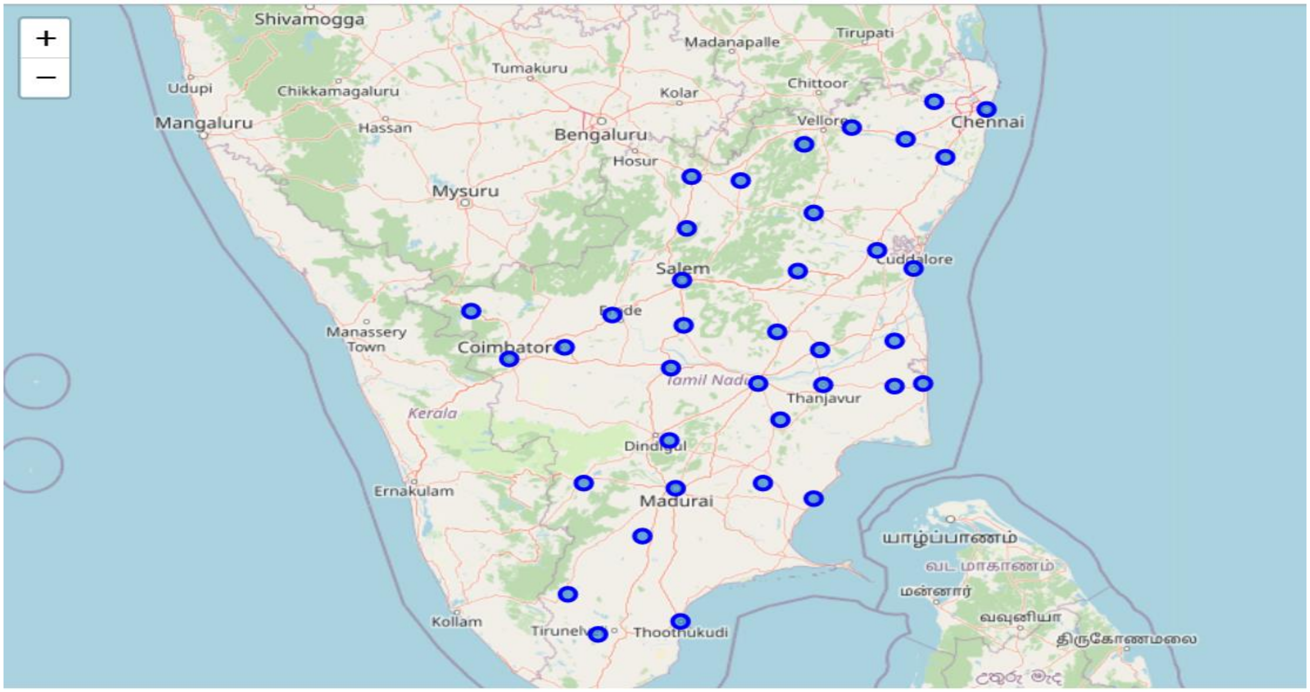
3.4. Correlation between Features

	Area	Population	Population_Density	Latitude	Longitude
Area	1	0.295268	-0.33469	-0.13857	-0.4122
Population	0.295268	1	0.519458	0.222161	0.096738
Population_Density	-0.33469	0.519458	1	0.261485	0.314549
Latitude	-0.13857	0.222161	0.261485	1	0.532381
Longitude	-0.4122	0.096738	0.314549	0.532381	1

3.5. Tamil Nadu Map

Folium is a Python library used for visualizing geospatial data. It is easy to use and yet a powerful library. **Folium** is a Python wrapper for Leaflet.js which is a leading open-source JavaScript library for plotting interactive maps.

It has the power of Leaflet.js and the simplicity of Python, which makes it an excellent tool for plotting maps. Folium is designed with simplicity, performance, and usability in mind. It works efficiently, can be extended with a lot of plugins, has a beautiful and easy-to-use API.

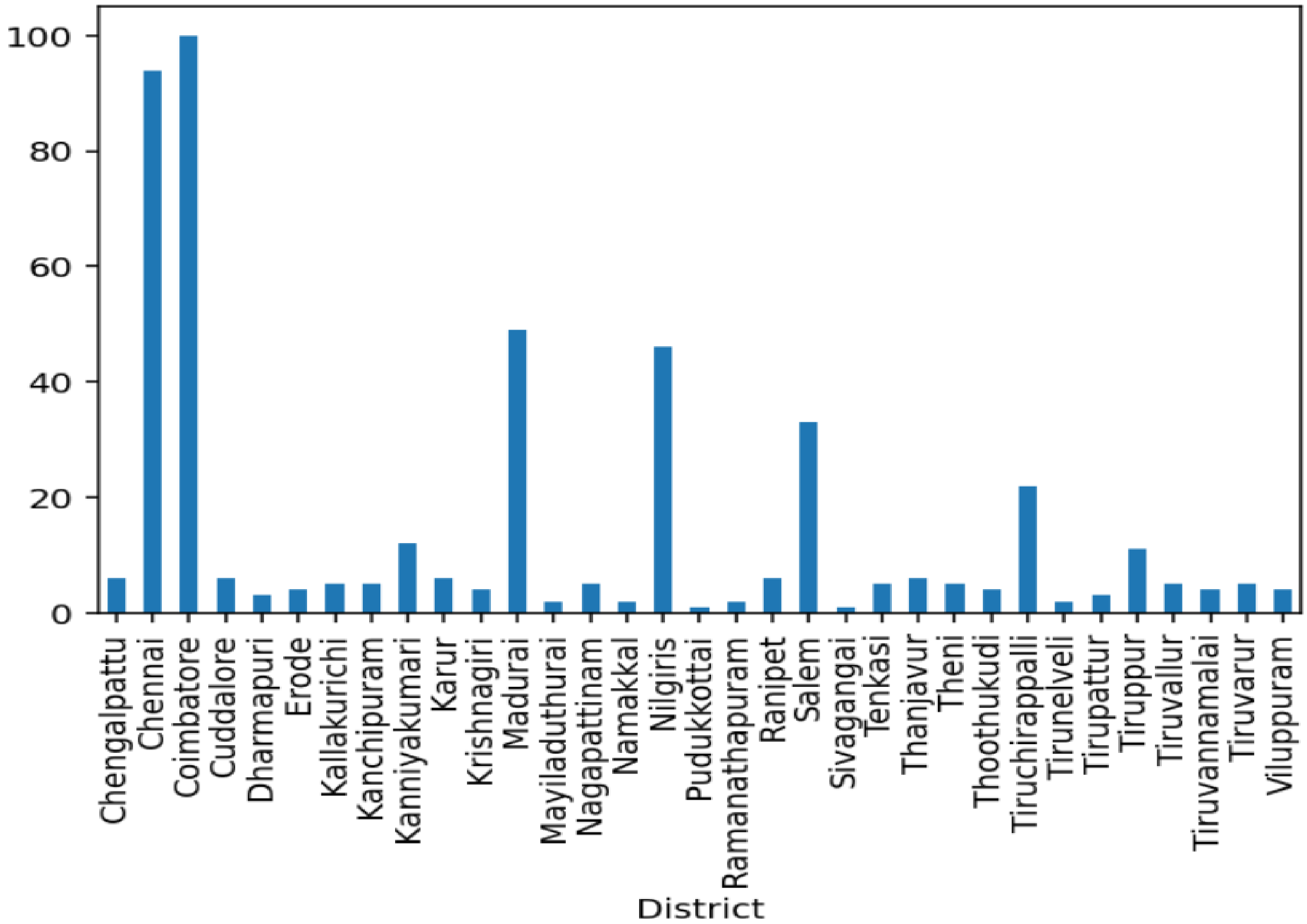


3.6. Grouping All the venues by District

Grouping gives the number of venues in the particular district.

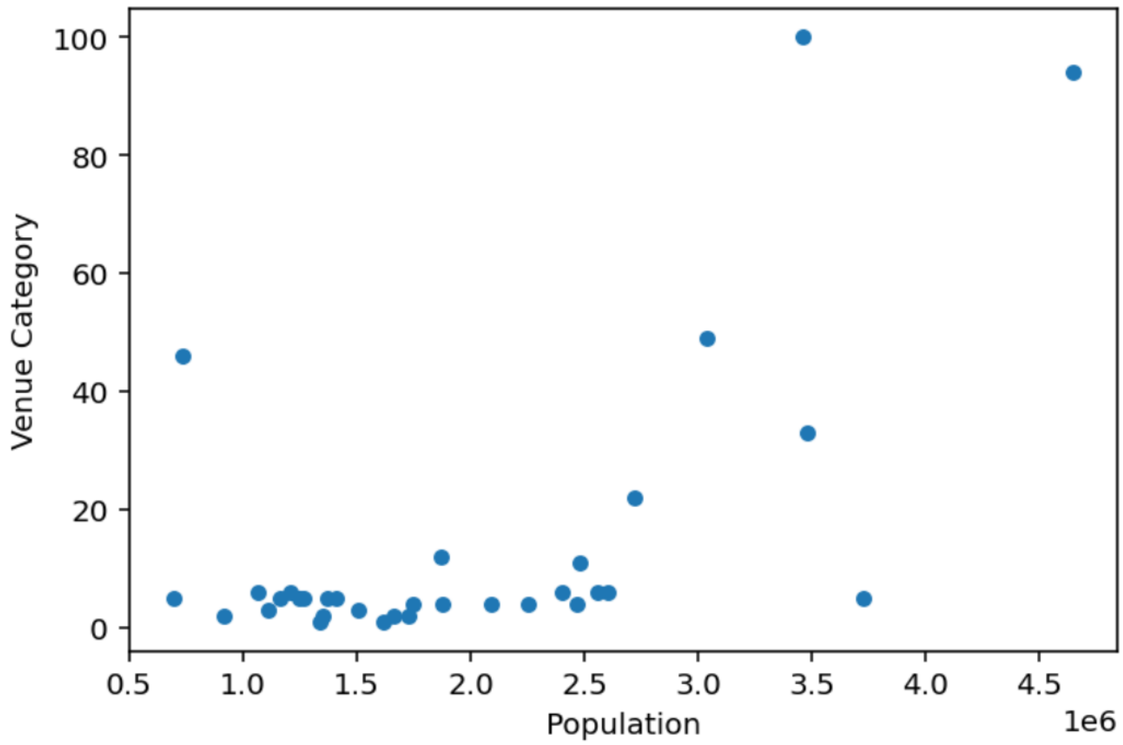
District	District Latitude	District Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Chengalpattu	6	6	6	6	6	6
Chennai	94	94	94	94	94	94
Coimbatore	100	100	100	100	100	100
Cuddalore	6	6	6	6	6	6
Dharmapuri	3	3	3	3	3	3

3.7. District vs Number of Venues



3.8 Population vs Number of venues

From the below plot we can understand that as the population increases the number of venues in the district also increases hence there is a linier dependecy between this features.



3.8 One-Hot Encoding

One-Hot Encoding makes the venues as feature and make them as zero or one based on the presence of the particular venue in that district.

	District	ATM	Accessories Store	African Restaurant	Arcade
10	Chennai	1	0	0	0
11	Chennai	0	0	0	0
12	Chennai	0	0	0	1
13	Chennai	0	0	0	0
14	Chennai	0	1	0	0

3.9 Taking mean of the individual venues in the respective District

	District	ATM	Accessories Store	African Restaurant	Arcade
0	Chengalpattu	0	0	0	0
1	Chennai	0	0	0.010638	0
2	Coimbatore	0	0.02	0	0
3	Cuddalore	0	0	0	0
4	Dharmapuri	0	0	0	0

4.Model Development

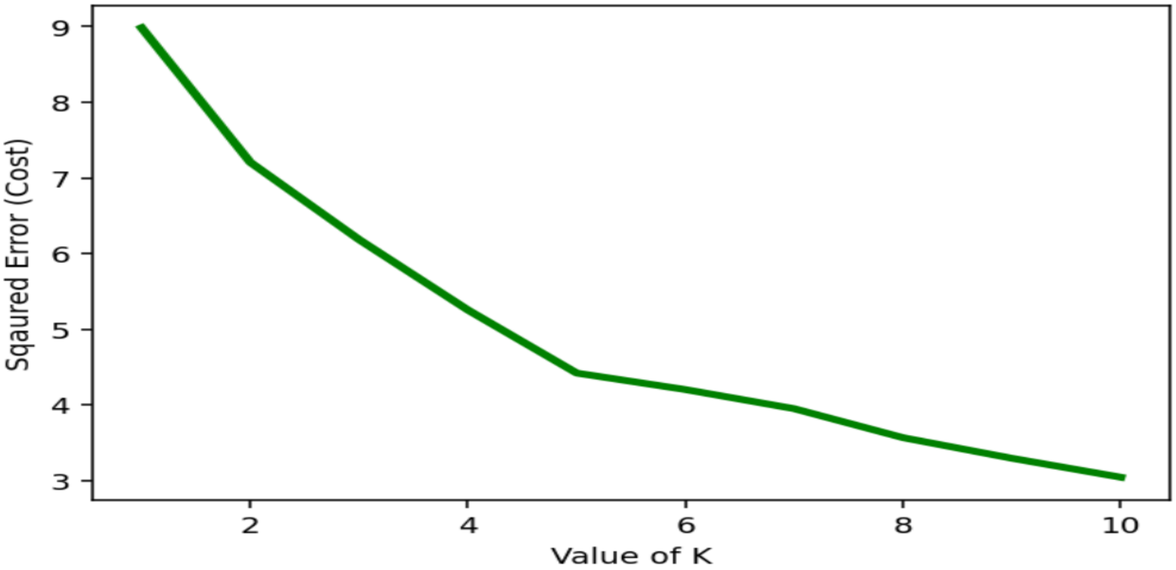
Clustering model

k-means clustering:

***k*-means clustering** is a method of vector quantization, originally from signal processing, that aims to partition *n* observations into *k* clusters in which each observation belongs to the cluster with the nearest mean (cluster centers or cluster centroid), serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. *k*-means clustering minimizes within-cluster variances (squared Euclidean distances), but not regular Euclidean distances, which would be the more difficult Weber problem: the mean optimizes squared errors, whereas only the geometric median minimizes Euclidean distances. For instance, better Euclidean solutions can be found using k-medians and k-medoids.

Elbow method

There is a popular method known as **elbow method** which is used to determine the optimal value of K to perform the K-Means Clustering Algorithm. The basic idea behind this method is that it plots the various values of cost with changing *k*. As the value of *K* increases, there will be fewer elements in the cluster. So average distortion will decrease. The lesser number of elements means closer to the centroid. So, the point where this distortion declines the most is the **elbow point**.



In the above figure there is a decline in the line which corresponds to k-value 5. So for k means algorithm we should take 5 as the k value.

Fit the Model and predict the labels.

There will be 5 clusters.

5.Results

There are five clusters. Each clusters has numbers of Districts and based on the Venues it has the districts are clustered. Within a Cluster all District has similar proporties. Cluster 1 has 10 districts and within that Districts the 1st common venue is Indian Restaurants. So this districts has some similarities and hence they are grouped together. The cluster 3 has more number of venues in the District and they are considerd as developed region. On the otherhand Cluster 5 has No venues in the Districts hence the cluster 5 is a under developed region. Cluster 2 has no similarities between the other clusters hence it is grouped into separate cluster.

Cluster 1

	District	Population	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
5	Dharmapuri	1506843	Optical Shop	Indian Restaurant	Bank	Electronics Store	Concert Hall
9	Kanchipuram	1166401	Indian Restaurant	Pizza Place	CafÃ©	Bus Station	Women's Store
12	Krishnagiri	1879809	Indian Restaurant	CafÃ©	Women's Store	Fast Food Restaurant	Convenience Store
13	Madurai	3038252	Indian Restaurant	Hotel	Movie Theater	Shopping Mall	Ice Cream Shop
16	Namakkal	1726601	Coffee Shop	Indian Restaurant	Fast Food Restaurant	Convenience Store	Cosmetics Shop
21	Ranipet	1210277	Indian Restaurant	Hotel	Asian Restaurant	Movie Theater	Women's Store
22	Salem	3482056	Indian Restaurant	Ice Cream Shop	Multiplex	Bakery	Shopping Mall
26	Theni	1245899	Indian Restaurant	Bus Station	Waterfall	Fast Food Restaurant	Convenience Store
29	Tirunelveli	1665253	Train Station	Indian Restaurant	Women's Store	Electronics Store	Concert Hall
33	Tiruvannamalai	2464875	Vegetarian / Vegan Restaurant	Resort	Indian Restaurant	CafÃ©	Women's Store

Cluster 2

	District	Population	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
19	Pudukkottai	1618345	Sculpture Garden	Women's Store	Electronics Store	Concert Hall	Convenience Store

Cluster 3

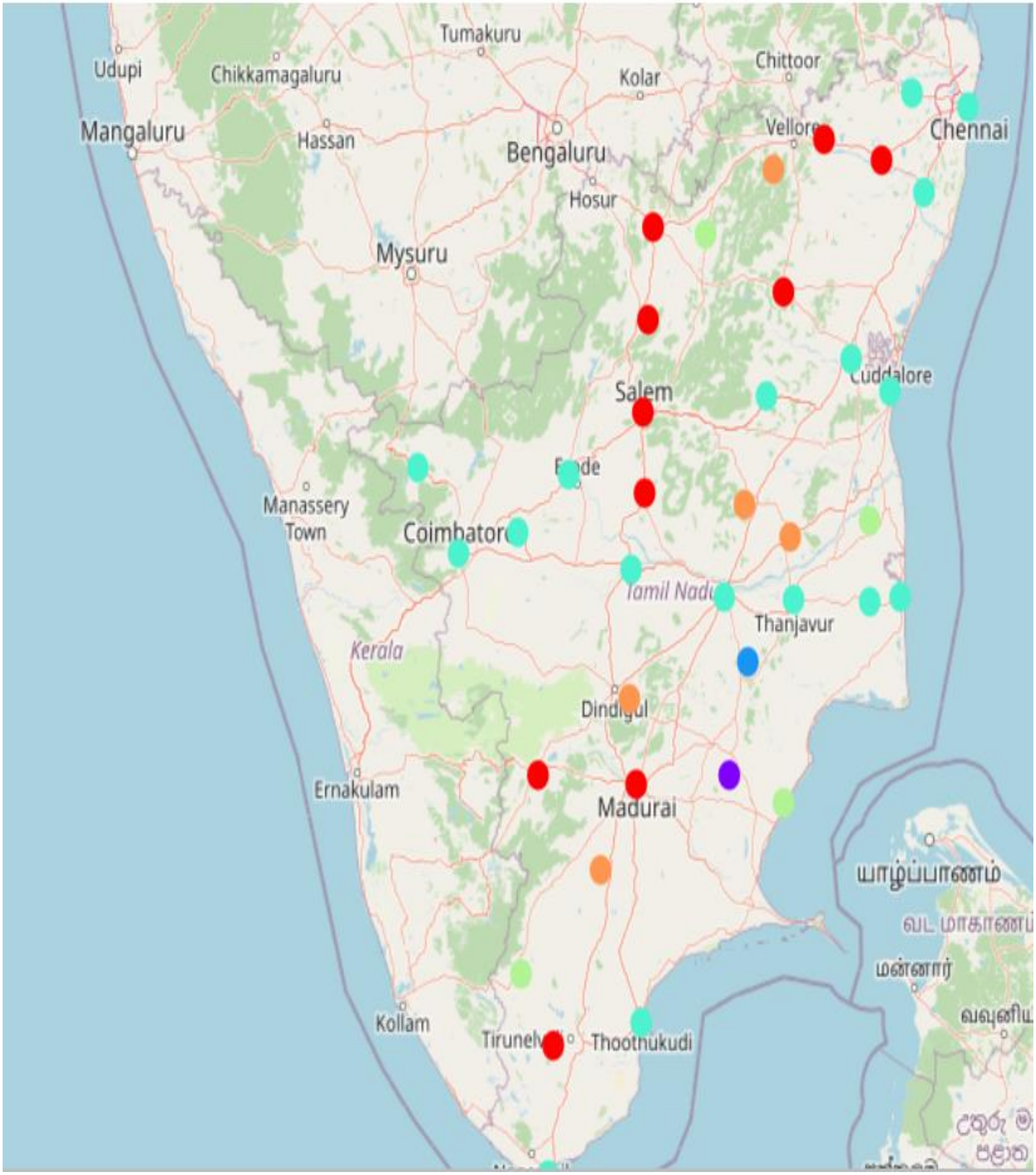
	District	Population	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
1	Chengalpattu	2556244	Light Rail Station	Train Station	Movie Theater	Toll Booth	Bus Station
2	Chennai	4646732	Indian Restaurant	Hotel	CafÃ©	Ice Cream Shop	Fast Food Restaurant
3	Coimbatore	3458045	Indian Restaurant	Clothing Store	Ice Cream Shop	Asian Restaurant	Multiplex
4	Cuddalore	2605914	Movie Theater	Beach	Vegetarian / Vegan Restaurant	Department Store	Women's Store
7	Erode	2251744	Clothing Store	Pizza Place	Food & Drink Shop	Outdoors & Recreation	Diner
8	Kallakurichi	1370281	ATM	Toll Plaza	Indian Restaurant	Restaurant	Bus Station
10	Kanniyakumari	1870374	Historic Site	Beach	Sculpture Garden	Resort	Castle
11	Karur	1064493	Train Station	Hotel	Ice Cream Shop	Food	Bus Station
15	Nagapattinam	697069	ATM	Pharmacy	Cosmetics Shop	Bus Station	Skating Rink
17	Nilgiris	735394	Hotel	Resort	Indian Restaurant	Vegetarian / Vegan Restaurant	CafÃ©
25	Thanjavur	2405890	Historic Site	Museum	Asian Restaurant	Ice Cream Shop	Bus Station
27	Thoothukudi	1750176	Shopping Mall	Harbor / Marina	CafÃ©	Women's Store	Electronics Store
28	Tiruchirappalli	2722290	Indian Restaurant	Hotel	Restaurant	Multiplex	Ice Cream Shop
31	Tiruppur	2479052	Clothing Store	Movie Theater	Bed & Breakfast	Food	Indian Restaurant
32	Tiruvallur	3728104	Historic Site	Train Station	Hotel	Indian Restaurant	Motorcycle Shop
34	Tiruvarur	1264277	Boarding House	Convenience Store	Train Station	Motorcycle Shop	Indie Movie Theater
36	Viluppuram	2093003	Vegetarian / Vegan Restaurant	Costume Shop	Asian Restaurant	Bus Station	Women's Store

Cluster 4

	District	Population	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
14	Mayiladuthurai	918356	ATM	History Museum	Concert Hall	Convenience Store	Cosmetics Shop
20	Ramanathapuram	1353445	ATM	Restaurant	Electronics Store	Concert Hall	Convenience Store
24	Tenkasi	1407627	ATM	Indian Restaurant	CafÃ©	Fast Food Restaurant	Convenience Store
30	Tirupattur	1111812	ATM	Train Station	Fast Food Restaurant	Concert Hall	Convenience Store

Cluster 5

	District	Population	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue
0	Ariyalur	754894	NaN	Nan	Nan	Nan	Nan
6	Dindigul	2159775	NaN	Nan	Nan	Nan	Nan
18	Perambalur	565223	NaN	Nan	Nan	Nan	Nan
35	Vellore	1614242	NaN	Nan	Nan	Nan	Nan
37	Virudhunagar	1942288	NaN	Nan	Nan	Nan	Nan


Tumakuru
Udupi
Chikkamagaluru
Kolar
Chittoor
Mangaluru
Hassan
Bengaluru
Vellore
Chennai
Hosur
Mysuru
Salem
Cuddalore
Erode
Manassery
Town
Coimbatore
Tamil Nadu
Thanjavur
Kerala
Dindigul
Ernakulam
Madurai
யாழ்ப்பாணம்
வட மாகாண
மன்னார்
வவுனிய
Kollam
Tirunelveli
Thoothukudi
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6.Discussion

Cluster 3 and 5 are Developed and under developed Districts respectively. Hence in cluster 3 there are number of venues and if a person want to open any restaurant or a shop in the Districts of Cluster 3 than there will be less profit, on the other hand Cluster 5 has under developed Districts in it so a person can open any venue there and there will be a great profit.

Developed Districts:

1. Chengalpattu
2. Chennai
3. Coimbatore
4. Cuddalore
5. Erode
6. Kallakurichi
7. Kanniyakumari
8. Karur
9. Nagapattinam
10. Nilgiris
11. Thanjavur
12. Thoothukudi
13. Tiruchirappalli
14. Tiruppur
15. Tiruvallur
16. Tiruvarur
17. Viluppuram

Under Developed Districts:

1. Ariyalur
2. Dindigul
3. Perambalur
4. Vellore
5. Virudhunagar

7. Conclusion

Tamil Nadu is a state in southern India. Its capital and largest city is Chennai. Tamil Nadu lies in the southernmost part of the Indian subcontinent and is bordered by the union territory of Puducherry and the South Indian states of Kerala, Karnataka, and Andhra Pradesh. It is bounded by the Eastern Ghats on the north, by the Nilgiri Mountains, the Meghamalai Hills, and Kerala on the west, by the Bay of Bengal in the east, by the Gulf of Mannar and the Palk Strait on the southeast, and by the Indian Ocean on the south. The state shares a maritime border with the nation of Sri Lanka.

In this project the data from the four square is used to cluster the Districts based on there similarities and it helped us to classify them as Developed and Under Developed Districts. This Classification helps people to know about a particular District and also helps to develop a business in a district.