Finding hospitals in the neighborhood of highly populated areas

1. Introduction

1.1. Problem Background

- Chennai, which was once known as Madras, is India's 4th largest city – and the 6th most populated region in the country

- Covid19 spreads with person to person contact.

- Do we have hospitals in and around the highly populated areas/wards?

- Most of the hospitals are located in the center of the city. People had options to choose the hospital and travel to the desired hospital. There were no doubts on availability of beds.

- In the current scenario of COVID19 and lockdown restrictions, movement is not easy in case of emergency.

1.2. Problem Description:

Chennai city is divided into the wards and population is measured at the ward level. Also Chennai is growing city with increase in the number of wards.

The first objective is to find the highly populated areas/wards are highly populated. Some of these wards can be in the center of the city and some in outskirts. Hospitals are not planned based on population density, number of hospitals in the same neighborhood. Given these, do we have hospitals in and around the highly populated areas/wards that is identified?

What is the radius in which the first hospital is available? In case, there are no beds in that hospital what are the list of other hospitals can be explored?

This should help an impacted person to be guided with quick insights so that emergency can be made better.

1.3. Success Criteria :

The success criteria of the project will be to identify the list of hospitals close by to the highly populated area.

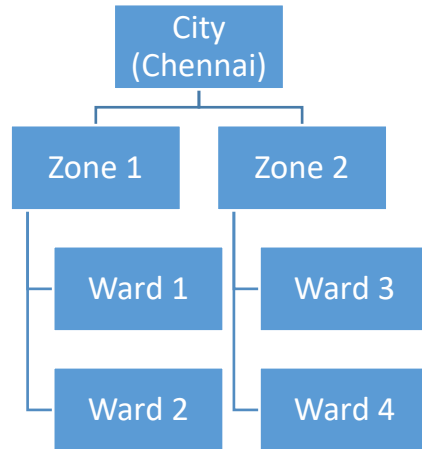## 2. Data Acquisition and Cleaning

2.1. Data Collection

Some of the data that could be of interest for solving this problem are given below.

- Areas / Wards in Chennai

- Population in each of the areas

- List of hospitals in the neighborhood of the highly populated area

Objective : Find the highly populated Regions in Chennai

Reference : https://en.wikipedia.org/wiki/List_of_Chennai_Corporation_zones

In Chennai, population data is available at the ward level.

2.2. Data Sources

- Wards in Chennai : can be obtained by scrapping the below web page

  http://www.tamilselvi.com/List-of-Corporation-wards-in-Chennai.html

	Ward No.	Ward Name
1	1	Kodungaiyur (West)
2	2	Kodungaiyur (East)
3	3	Dr.Radhakrishnan Nagar (North)
4	4	Cheriyan Nagar (North)
5	5	Jeeva Nagar (North)

- Population in each of the ward is available in Population.xls. This file is downloaded from below URL

  https://data.gov.in/catalog/area-wise-population-within-corporations-and-municipalities-tamil-nadu?filters%5Bfield_catalog_reference%5D=85975&format=json&offset=0&limit=6&sort%5Bcreated%5D=desc

State Code	District Code	Tahsil/ Sub-District Code	Town/ Village Code	Ward Code	Enumeration Block Code	Level	Name	Total/ Rural/ Urban	Total - Persons	Total - Males	Total - Females	Scheduled Caste - Persons	Scheduled Caste - Males	Scheduled Caste - Females	Scheduled Tribe - Persons
33	2	0	0	0	0	DISTRICT	Chennai	Total	4343645	2219539	2124106	598110	301835	296275	6728
33	2	0	0	0	0	DISTRICT	Chennai	Rural	0	0	0	0	0	0	0
33	2	0	0	0	0	DISTRICT	Chennai	Urban	4343645	2219539	2124106	598110	301835	296275	6728
33	2	0	40201000	0	0	TOWN	Chennai (M Corp.)	Urban	4343645	2219539	2124106	598110	301835	296275	6728
33	2	0	40201000	1	0	WARD	Chennai (M Corp.) - Ward No.1	Urban	57723	29449	28274	4477	2271	2206	46

- List of all Hospitals in the neighborhood from foursquare

  Use geographical coordinates data of the 'highly populated ward' as input for the Foursquare API. As the focus is on finding the list of hospitals, hospital as a venue category is another input.

  The below is image of the Foursquare API data

name	categories	referralId	hasPerk	location.lat	location.lng	location.labeledLatLngs	location.distance	location.postalCode	location.cc	location.c
Parms Laboratory	[{'id': '4f4531b14b9074f6e4fb0103', 'name': 'M...	v-1592507526	False	13.104899	80.207886	[{'label': 'display', 'lat': 13.104899, 'lng':...	1438	600049	IN	Chen
Madras Medical Mission (MMM Hospital)	[{'id': '4bf58dd8d48988d196941735', 'name': 'H...	v-1592507526	False	13.085986	80.187398	[{'label': 'display', 'lat': 13.08598577011605...	4401	600037	IN	Chen
MaxiVision Eye Hospital	[{'id': '4bf58dd8d48988d196941735', 'name': 'H...	v-1592507526	False	13.092917	80.218327	[{'label': 'display', 'lat': 13.09291696556728...	2749	NaN	IN	Chen
Damien Foundation	[{'id': '4bf58dd8d48988d196941735',	v-...	False	13.072126	80.201814	[{'label': 'display', 'lat':	5128	NaN	IN	Chen

2.3. Data Cleaning and Feature Selection

2.3.1. Data Source 2 : Population in each of the ward

State Code	District Code	Tahsil/ Sub-District Code	Town/ Village Code	Ward Code	Enumeration Block Code	Level	Name	Total/ Rural/ Urban	Total - Persons	Total - Males	Total - Females	Scheduled Caste - Persons	Scheduled Caste - Males	Scheduled Caste - Females	Scheduled Tribe - Persons
33	2	0	0	0	0	DISTRICT	Chennai	Total	4343645	2219539	2124106	598110	301835	296275	6728
33	2	0	0	0	0	DISTRICT	Chennai	Rural	0	0	0	0	0	0	0
33	2	0	0	0	0	DISTRICT	Chennai	Urban	4343645	2219539	2124106	598110	301835	296275	6728
33	2	0	40201000	0	0	TOWN	Chennai (M Corp.)	Urban	4343645	2219539	2124106	598110	301835	296275	6728
33	2	0	40201000	1	0	WARD	Chennai (M Corp.) - Ward No.1	Urban	57723	29449	28274	4477	2271	2206	46

Kept Features	Dropped Features	Reason for dropping Features

Ward Code, Ward Name, Total-Persons	State Code, District code	State Code, District code : Same for all rows
	Village Code	Village Code : Not applicable
	Gender based or Religion / community based	Gender based or Religion / community based – Not Applicable

	Ward Code	Total - Persons
State Code		
33	0	4343645
33	0	0
33	0	4343645
33	0	4343645
33	1	57723
...	...	...
33	151	38366
33	152	24555
33	153	95818
33	154	41627
33	155	78007

159 rows × 2 columns

Remove samples with missing data such population is zero

```
1       1
2       2
3       3
4       4
5       5
       ...
148    140
149    141
151    142
152    143
153    144
Name: Ward No., Length: 144, dtype: object
```
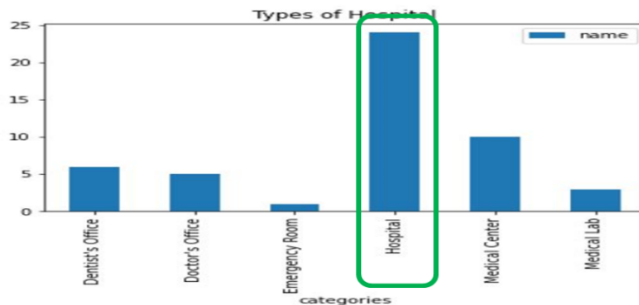
2.3.2. Data Source 3 : List of all Hospitals in the neighborhood from foursquare

Step 1: Foursquare API to fetch only details of Venue category type of "Hospital"

Kept Features	Dropped Features	Reason for dropping Features
Venue Category of type Hospital	All other Venue Categories are dropped	Hospitals is the focus area

Step 2 : Sub Categories under Hospital

	name	distance	lat	lng	id
categories					
Alternative Healer	1	1	1	1	1
Dentist's Office	4	4	4	4	4
Doctor's Office	5	5	5	5	5
Emergency Room	1	1	1	1	1
Eye Doctor	1	1	1	1	1
Hospital	22	22	22	22	22
Medical Center	9	9	9	9	9
Medical Lab	1	1	1	1	1
Veterinarian	1	1	1	1	1

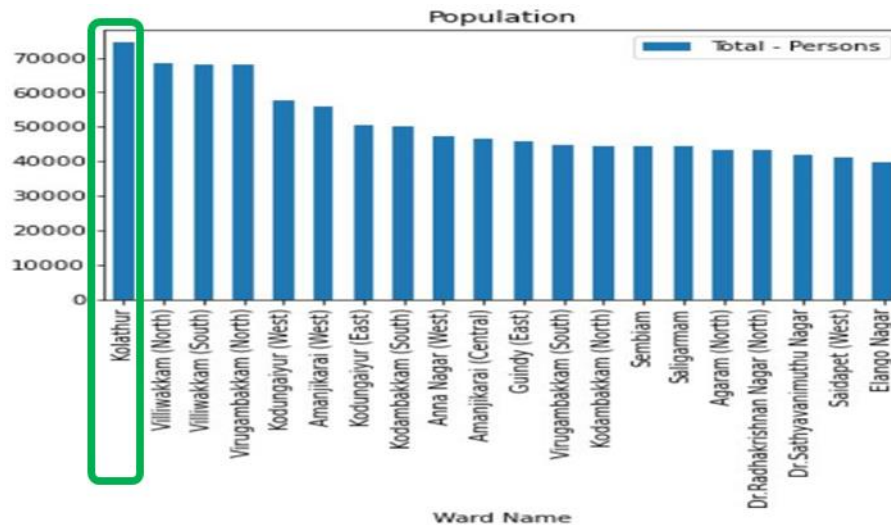| Kept Features	Dropped Features	Reason for dropping Features
Venue Category of type Hospital	All other Venue Categories such as Dentist's office, Doctor's office, labs are dropped	For Covid 19, information on hospitals are required. Dentist, Doctor's office and labs are not of focus in this context

Step 3 : Feature Selection

name	categories	referralId	hasPerk	location.lat	location.lng	location.labeledLatLngs	location.distance	location.postalCode	location.cc	location.c
Parms Laboratory	[{'id': '4f4531b14b9074f6e4fb0103', 'name': 'M...	V-1592507526	False	13.104899	80.207886	[{'label': 'display', 'lat': 13.104899, 'lng':...	1438	600049	IN	Chen
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MaxiVision Eye Hospital	[{'id': '4bf58dd8d48988d196941735', 'name': 'H...	V-1592507526	False	13.092917	80.218327	[{'label': 'display', 'lat': 13.09291696556728...	2749	NaN	IN	Chen
Damien Foundation	[{'id': '4bf58dd8d48988d196941735',	V-	False	13.072126	80.201814	[{'label': 'display', 'lat':	5128	NaN	IN	Chen

Kept Features	Dropped Features	Reason for dropping Features
Name, location.lat, location.lng, Id, distance	hasPerk, PostalCode,referralID, city	hasPerk, referralID, city : All rows have same value PostalCode : Many missing data

3. Exploratory Data Analysis

Step 1 : Visualize the population in different areas in Chennai to identify highly populated regions

Shortlist "Kolathur" as the highly Populated Area

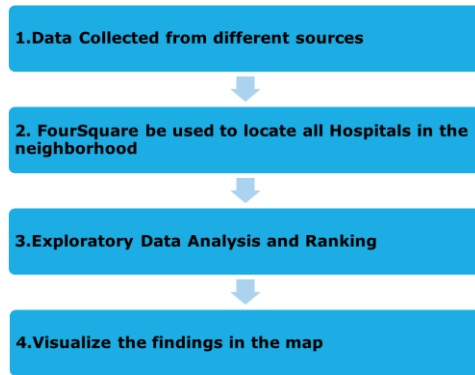**Step 2 : List of hospitals after data cleansing is available in the dataframe**
Next step is to rank the hospitals based on its distance from "Kolathur"

	distance_rank	name	categories	distance	lat	lng	id
0	3.0	Sridevi Hospitals	Hospital	3508	13.088418	80.198918	4d5769fdafe4b60cb0934461
1	4.0	soundarapandian	Hospital	3715	13.083676	80.214851	4ff6938fe4b058e164cf8dd9
2	5.0	Apollo Medical Centre	Hospital	3744	13.084527	80.221720	58a11a11fc73d453c2995729
3	6.0	Ashwin Clinic	Hospital	3875	13.082277	80.215457	5604e217498e96c19e4ae389
4	7.0	Sundaram Medical Foundation OP Services	Hospital	3938	13.081995	80.207172	4f06ef92e4b0ad9c23935a9c
5	8.0	km hospital	Hospital	4298	13.088939	80.239872	528e21cc11d2871318e3852b
6	9.5	Madras Medical Mission (MMM Hospital)	Hospital	4401	13.085986	80.187398	4cccf3d8ba79a1cdf6c83ecb
7	9.5	physiotherapy clinic	Hospital	4401	13.089308	80.241615	528e1a2511d279f7d736786f
8	11.0	Frontier Lifeline Hospital	Hospital	4448	13.087158	80.185292	519b1365498e484c03997d3a

First hospital is found at the distance of 3.5KM from Kolathur.

4. Solution to the Problem

Methodology followed to solve this problem

1. Data Collected from different sources

2. FourSquare be used to locate all Hospitals in the neighborhood

3. Exploratory Data Analysis and Ranking

4. Visualize the findings in the map

Problem 1 : Do we have hospitals in and around the highly populated areas/wards that is identified?

There are 20 hospitals around kolathur each of them are at different distance and located in different locations

Problem 2 : What is the radius in which the first hospital is available?

First hospital is available at 3.5KM distance from Kolathur

Problem 3: In case, there are no beds in that hospital what are the list of other hospitals can be explored?

Here is the list of other hospitals that can be explored.

	distance_rank	name	categories	distance	lat	lng	id
0	3.0	Sridevi Hospitals	Hospital	3508	13.088418	80.198918	4d5769fdafe4b60cb0934461
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2	5.0	Apollo Medical Centre	Hospital	3744	13.084527	80.221720	58a11a11fc73d453c2995729
3	6.0	Ashwin Clinic	Hospital	3875	13.082277	80.215457	5604e217498e96c19e4ae389
4	7.0	Sundaram Medical Foundation OP Services	Hospital	3938	13.081995	80.207172	4f06ef92e4b0ad9c23935a9c
5	8.0	km hospital	Hospital	4298	13.088939	80.239872	528e21cc11d2871318e3852b
6	9.5	Madras Medical Mission (MMM Hospital)	Hospital	4401	13.085986	80.187398	4cccf3d8ba79a1cdf6c83ecb
7	9.5	physiotherapy clinic	Hospital	4401	13.089308	80.241615	528e1a2511d279f7d736786f
8	11.0	Frontier Lifeline Hospital	Hospital	4448	13.087158	80.185292	519b1365498e484c03997d3a

Details of the hospitals are available as given below. This can be used to reaching out to the hospital to check availability

```
Address ['Chennai', 'Tamil Nadu', 'India']
Likes 0
Tips  0
Hospital Name soundarapandian
Contact {}
Address ['India']
Likes 0
Tips  0
Hospital Name Apollo Medical Centre
Contact {}
Address ['India']
Likes 1
Tips  0
Hospital Name Ashwin Clinic
Contact {}
Address ['India']
Likes 0
Tips  0
Hospital Name Sundaram Medical Foundation OP Services
Contact {}
Address ['Chennai', 'Tamil Nadu', 'India']
Likes 0
Tips  1
Hospital Name km hospital
Contact {}
Address ['India']
Likes 0
Tips  0
Hospital Name Madras Medical Mission (MMM Hospital)
Contact {'phone': '+914426565961', 'formattedPhone': '+91 44 2656 5961'}
Address ['4-A, Dr. J. Jayalalitha Nagar, (Mogappair)', 'Chennai 600037', 'Tamil Nadu', 'India']
Likes 2
Tips  4
Hospital Name physiotherapy clinic
Contact {}
Address ['India']
Likes 0
Tips  0
Hospital Name Frontier Lifeline Hospital
Contact {}
Address ['India']
```
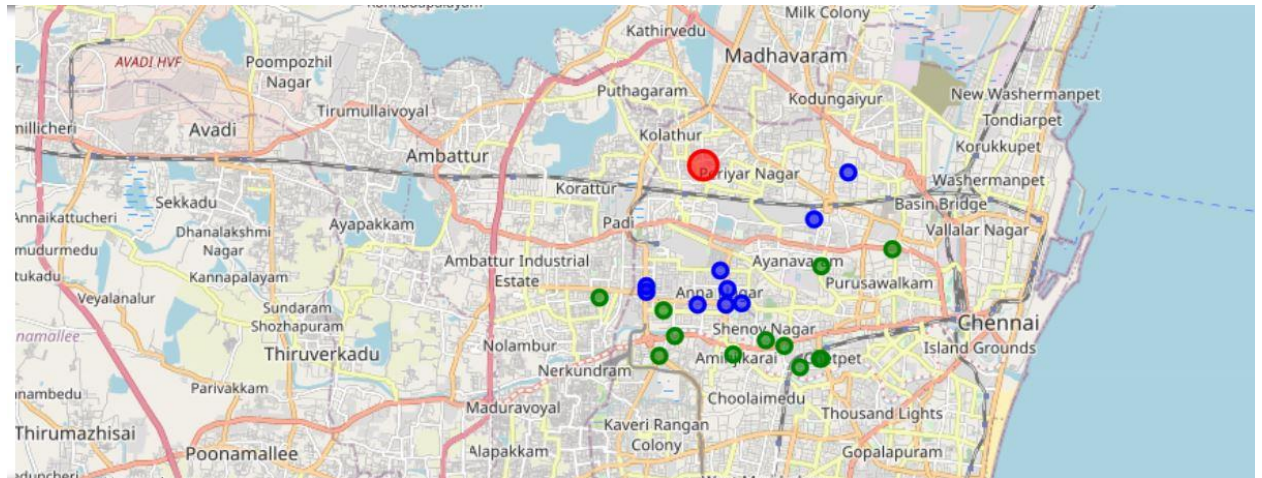
Limitations
- The accuracy of data depends purely depends on the data provided by FourSquare
- Number of Foursquare API is limited for developer version, hence number of sample to be extracted is optimized
- Details such as Phone number and address are not available for all the hospitals currently

5. Conclusion
- Kolathur is highly Populated Areas in Chennai
- No hospitals in within 3.5 KM from highly populated area identified (Kolathur) (First hospital is found at the distance of 3.5KM from Kolathur)

Findings are grouped into 2 clusters and color coded for the ease of presentation
First cluster is 10 hospitals closer to the highly populated area is **blue**
Second cluster is the remaining hospitals denoted in **green**

6. Future Work

This is an example of how data analysis can help people find list of hospitals given
constraints of lockdown and distance
This model can be integrated with COVID19 applications for recommending medical help in
remote locations of the city

7. References

https://worldpopulationreview.com/world-cities/chennai-population/