Tel Aviv Restaurants Analysis

Snir Levi

March 1, 2021

1. Introduction

1.1 Background

Tel Aviv is the most populous city in the Gush Dan metropolitan area of Israel. Located on the Israeli Mediterranean coastline with a population of 460,613, it is the economic and technological center of the country but also famous for its wide variety of world-class restaurants; people come to Tel Aviv from all over the country in order to eat different kinds of food, from street food to fine dining's.

1.2 The Problem

As for the end of 2020, there are more than 12,000 restaurants in Israel but without a doubt, the best place in Israel to open a restaurant is Tel Aviv, since it's a small city the competition can be very high; more than 33% of the restaurants in Israel will close after 1 year and 50% after 2 years, with such a terrifying statistics the location of the restaurant become a top priority issue for the entrepreneur.

1.3 Interest

This project has 2 goals:

1. Create a model which will allows a visualization of different types of restaurants locations, this will help entrepreneurs find the best location for their new restaurant.
2. Create a model which allows clustering of different locations and Tel Aviv, this will help entrepreneurs to decide what the best location to open a similar restaurant is.

2. Data Description

2.1 Data Sources

In order to develop the model, I used the following sources:

I split Tel Aviv to 8 different areas which cover most of Tel Aviv:

```
'Rothschild', 'Kikar Hamdina', 'Hatahana', 'TLV Lev', 'Beach', 'Ramat H
ahayal', 'Ramat Aviv', 'Drom TA'
```

I used the geo location (https://www.latlong.net/) website in order to find the locations of these areas:

```
'Latitude': [32.06730651855469, 32.0868522, 32.05824516363195, 32.06613
24, 32.083150, 32.112790, 32.108110, 32.052250],

'Longitude': [34.778079986572266, 34.7898459, 34.76291204921263, 34.783
1839, 34.770640, 34.835230, 34.796760, 34.777730]}
```

- I used **Foursquare API** to get the common venues of a given location.
- The data will be cleaned and aggregated to restaurants categories

2.2 Data Cleaning

After loading the data we receive over 600 results:

	Location	Location Latitude	Location Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Rothschild	32.067307	34.77808	שמנמנת	32.066818	34.779314	Café
1	Rothschild	32.067307	34.77808	(Itzik & Ruti) איציק ורותי	32.068474	34.776812	Sandwich Place
2	Rothschild	32.067307	34.77808	Delicatessen	32.064339	34.777098	Café
3	Rothschild	32.067307	34.77808	Bucke (בוקה)	32.070770	34.777895	Café
4	Rothschild	32.067307	34.77808	גרציאני	32.068608	34.780461	Bakery
...	...	...	...	...	...	...	...
602	Drom TA	32.052250	34.77773	Tometomato	32.055378	34.769524	Italian Restaurant
603	Drom TA	32.052250	34.77773	Bretonne	32.055800	34.769424	Creperie
604	Drom TA	32.052250	34.77773	Dganit & The Seven Dwarves (דגנית ושבעת הגמדים)	32.059973	34.774175	Café
605	Drom TA	32.052250	34.77773	Cordovero 21	32.056829	34.769490	Diner
606	Drom TA	32.052250	34.77773	Hakabina Cafe	32.056232	34.768933	Café

We need to find out which restaurants categories appear in our data frame, we will count the occurrence of each unique value in the column 'Venue Category':

Café	131
Bakery	46
Mediterranean Restaurant	41
Middle Eastern Restaurant	36
Italian Restaurant	35
Restaurant	25
Israeli Restaurant	21
Seafood Restaurant	21
Pizza Place	20
Vegetarian / Vegan Restaurant	19
Falafel Restaurant	16
Asian Restaurant	15
Burger Joint	15
Fast Food Restaurant	14
Breakfast Spot	11
Sushi Restaurant	11
Thai Restaurant	9
Sandwich Place	8
Japanese Restaurant	8
Bistro	8
Steakhouse	6
Tapas Restaurant	6
French Restaurant	6
Diner	6
Mexican Restaurant	5
BBQ Joint	5
Deli / Bodega	5
Gastropub	5
Persian Restaurant	4
Soup Place	4
American Restaurant	3
Indian Restaurant	3
German Restaurant	3
Eastern European Restaurant	3
Comfort Food Restaurant	3
Food	2
Chinese Restaurant	2
Moroccan Restaurant	2
Kosher Restaurant	2
Argentinian Restaurant	2
Food Court	2
Vietnamese Restaurant	2
Irish Pub	2
Noodle House	1
Ramen Restaurant	1
Bagel Shop	1
Caribbean Restaurant	1
Modern Greek Restaurant	1
Molecular Gastronomy Restaurant	1
Hot Dog Joint	1
Salad Place	1
Ethiopian Restaurant	1
Snack Place	1
Jewish Restaurant	1
Creperie	1
Greek Restaurant	1
Cafeteria	1

We can see that some restaurants categories can be merged to one category, there are more than 20 different categories which needed to be aggregated with other categories, we will use dictionary list in order to change the names of specific categories to the main category:

```
venues_dic = {'Café': 'Cafe',
              'Bakery': 'Cafe',
              'Breakfast Spot': 'Cafe',
              'Bagel Shop': 'Bakery',
              'Israeli Restaurant': 'Mediterranean Restaurant',
              'Middle Eastern Restaurant': 'Mediterranean Restaurant',
              'Sushi Restaurant': 'Japanese Restaurant',
              'Ramen Restaurant': 'Japanese Restaurant',
              'Kosher Restaurant': 'Kosher Restaurant',
              'Deli / Bodega': 'Sandwich Place',
              'BBQ Joint': 'Steakhouse',
              'Restaurant': 'Diner',
              'American Restaurant': 'Diner',
              'Food': 'Diner',
              'Hot Dog Joint': 'Fast Food Restaurant',
              'Jewish Restaurant': 'Kosher Restaurant',
              'Noodle House': 'Chinese Restaurant',
              'Salad Place': 'Vegetarian / Vegan Restaurant',
              'Creperie': 'Cafe',
              'Cafeteria': 'Sandwich Place',
              'Modern Greek Restaurant': 'Greek Restaurant'}
```

After cleaning the data we receive 39 different restaurants categories instead of 60.

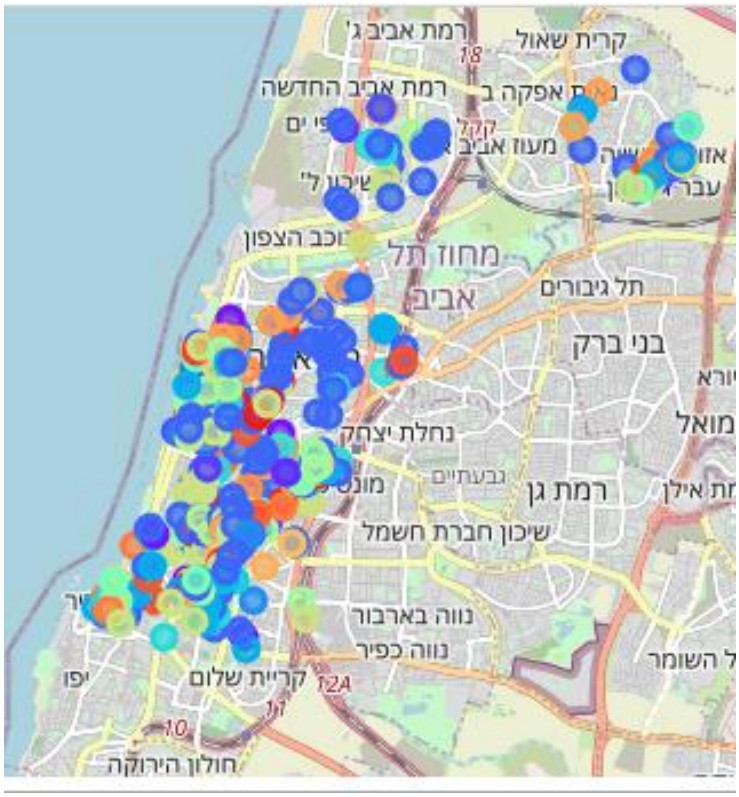
3. Exploratory Data Analysis

3.1 Tel Aviv restaurants distribution

TouristIsrael.com: "Tel Aviv was founded in 1909 as a suburb north of the ancient city of Jaffa, believed to be the oldest port in the world. The suburb grew and grew and eventually overtook Jaffa in size, merging with it after Israel's independence to form a single municipality. Today, Old Jaffa is a pretty collection of quaint alleys in the southern part of the city, while downtown Tel Aviv lies at the heart of the Israeli hi-tech industry known as Silicon Wadi. The Tel Aviv Diamond Exchange, the largest diamond trading center in the world, is also situated in the city.
Immigrants have come to Tel Aviv from far and wide, bringing with them their own styles, cuisine, culture, and architecture. As such, no matter what you are after, you'll be sure to find it here. Tel Aviv is world-renowned for its high-quality restaurants and a world-class cafe culture, as well as a superb nightlife scene."

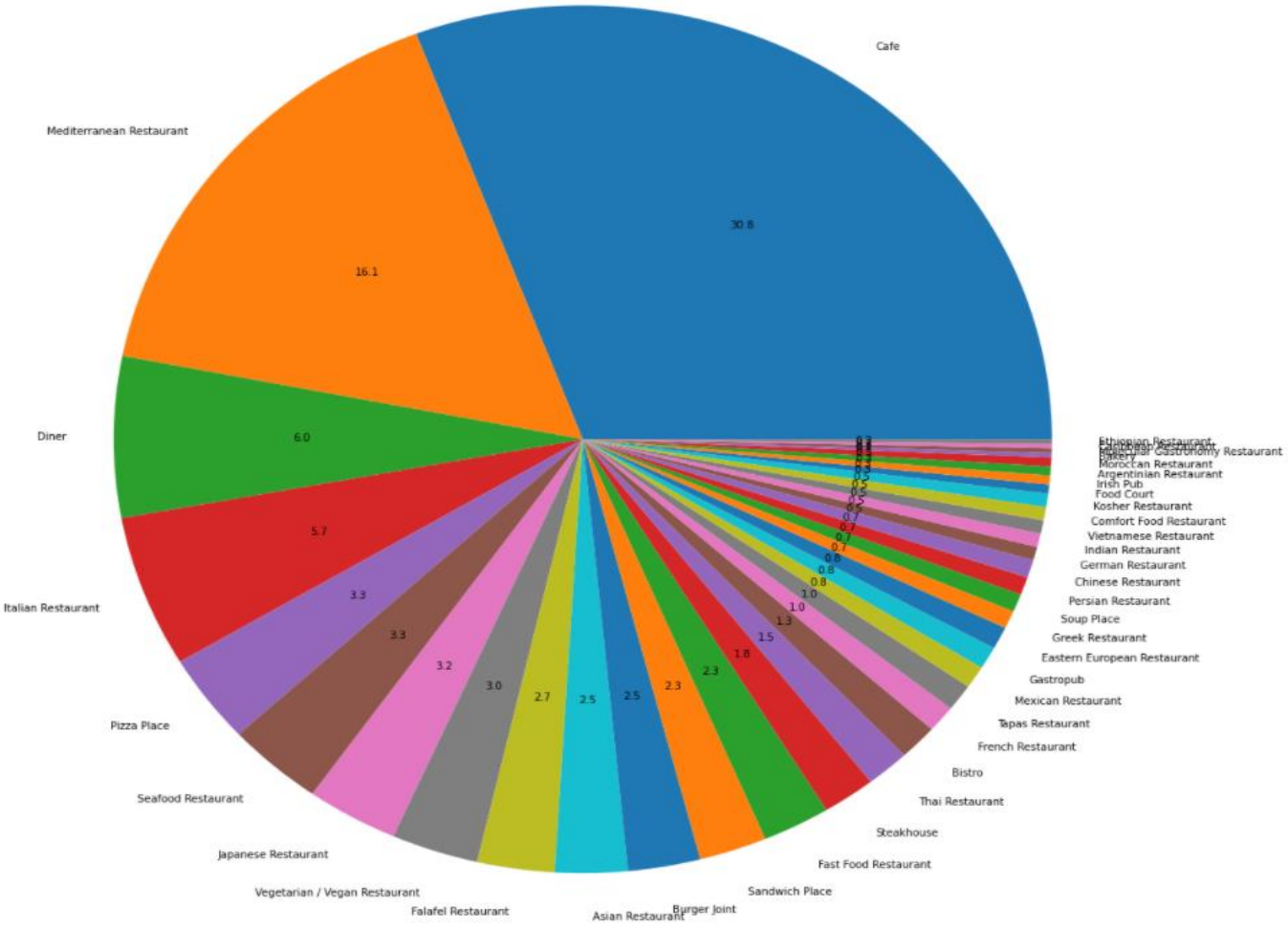
Folium will be used in order to check the restaurants distribution in Tel-Aviv, Folium is an interactive map which allows to pin different points of interest and to group them by certain criteria.

The results show that Tel-Aviv has a lot of different restaurants located on a small area, the blue points indicates Café shops, it seems that this is the main type of restaurants in Tel Aviv, this argument will be explored in the next section.



3.2 Venue categories distribution

In order to receive the categories distribution we will use a pie chart:



Almost 1/3 of the restaurants in Tel-Aviv are Café, it means that there is a large competition in this type, the 2nd common type is 'Mediterranean Restaurants', the 3rd is 'Diner' and the 4th is 'Italian Restaurants'.

Other restaurants types have a market share of less than 3.5% for each category, in order to avoid competition those types of restaurants will be preferable.

3.3 Locations Summary

Now those we have information regarding the distribution of different types of restaurants in Tel Aviv, we can group the data for each neighborhood and to summary the results.

This process will allow us to use clustering model on the next section and to find out which location have similarity, this can help understand the market better and to give us tools to determine where is the best location to open a new restaurant.

Location	Location Latitude	Location Longitude	N1 Venue Type	N2 Venue Type	N3 Venue Type	N4 Venue Type	N5 Venue Type
Beach	32.083150	34.770640	Cafe	Mediterranean Restaurant	Sandwich Place	Italian Restaurant	Falafel Restaurant
Drom TA	32.052250	34.777730	Cafe	Mediterranean Restaurant	Diner	Italian Restaurant	Eastern European Restaurant
Hatahana	32.058245	34.762912	Mediterranean Restaurant	Cafe	Diner	Italian Restaurant	Seafood Restaurant
Kikar Hamdina	32.086852	34.789846	Cafe	Mediterranean Restaurant	Pizza Place	Italian Restaurant	Fast Food Restaurant
Ramat Aviv	32.108110	34.796760	Cafe	Mediterranean Restaurant	Pizza Place	Fast Food Restaurant	Bistro
Ramat Hahayal	32.112790	34.835230	Cafe	Mediterranean Restaurant	Fast Food Restaurant	Sandwich Place	Italian Restaurant
Rothschild	32.067307	34.778080	Cafe	Mediterranean Restaurant	Diner	Italian Restaurant	Vegetarian / Vegan Restaurant
TLV Lev	32.066132	34.783184	Cafe	Italian Restaurant	Mediterranean Restaurant	Seafood Restaurant	Japanese Restaurant

A quick look on the data shows that there is large similarity among the locations in respect for the 1st and 2nd restaurants types.

We will use clustering algorithm in order to find out which location has similar characteristics.

4. Visualization and Predictive Modeling

At the beginning of this research, we aim to find solutions for 2 questions:

1. Create a model which will allows a visualization of different types of restaurants locations, this will help entrepreneurs find the best location for their new restaurant.
2. Create a model which allows clustering of different locations and Tel Aviv, this will help entrepreneurs to decide what the best location to open a similar restaurant is.

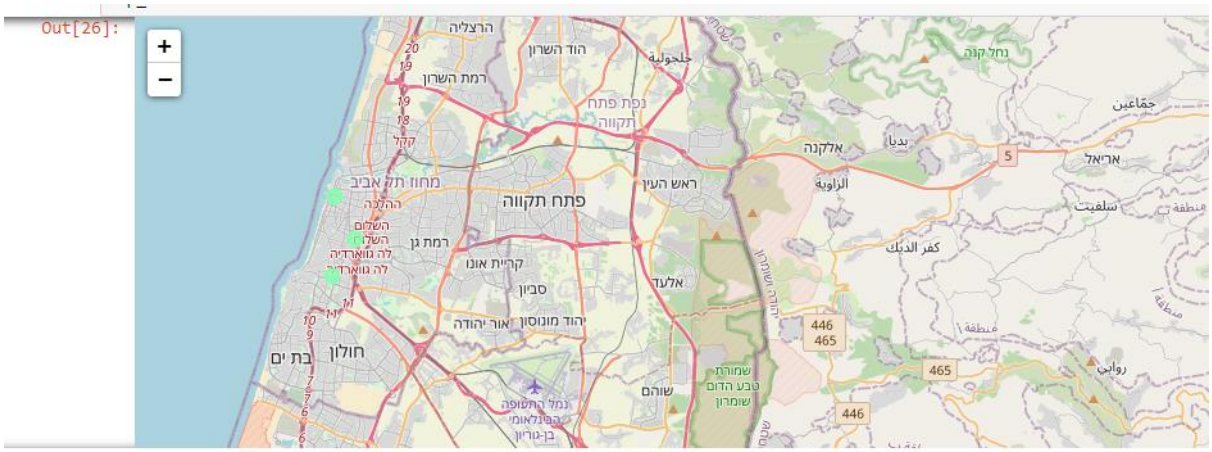
For the 1st question we will use a visualization model which receives a restaurant type as an input and shows a graphic view of the different restaurants locations in Tel Aviv.

For 2nd question we will use a clustering model (K-Means) in order to find similarity between locations and to group Tel Aviv locations.

4.1 Visualization Model - Indian Restaurant Case

An entrepreneur would like to open new Indian Restaurant, in order to reduce competition we will use the model to show the locations of currently open competitors

Out[26]:



In [27]:
```
spec_venues.head()
```

Out[27]:

	Location	Location Latitude	Location Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category	Category Number
359	TLV Lev	32.066132	34.783184	Ma Pau	32.069523	34.784695	Indian Restaurant	19
424	Beach	32.083150	34.770640	Dosa Bar	32.088751	34.773720	Indian Restaurant	19
578	Drom TA	32.052250	34.777730	24 Rupee	32.053048	34.772101	Indian Restaurant	19

Only 3 Indian Restaurants are available in Tel Aviv, in 'TLV Lev', 'Beach' and 'Drom TA', it might be a good opportunity to open a new one, we will use the clustering model in order to find out where is the best place.

4.2 Predictive Model - Indian Restaurant Case

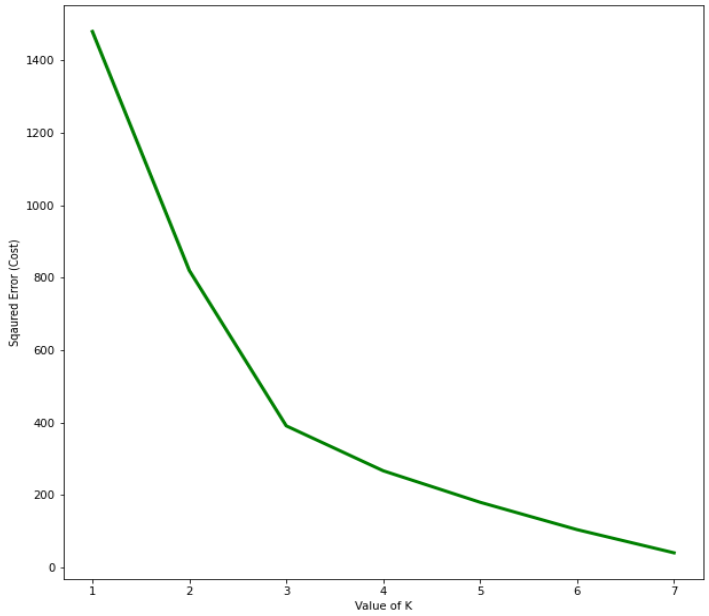
In order to use a predictive model we need to use a clustering criterion, in order to do this we first need to assign for each venue category a column and to sum the amount of each category type on a location:

Location	Location Latitude	Location Longitude	Cafe	Sandwich Place	Italian Restaurant	Gastropub	Asian Restaurant	French Restaurant	Mediterranean Restaurant	Mexican Restaurant	Vegetarian / Vegan Restaurant	Fast Food Restaurant	...	Vietnamese Restaurant	Greek Restaurant	Chinese Restaurant	German Restaurant	Indian Restaurant	Bakery	Irish Pub	Caribbean Restaurant	Food Court	Ethiopian Restaurant
Beach	32.083150	34.770640	32.0	6.0	6.0	0.0	1.0	0.0	13.0	1.0	3.0	0.0	...	1.0	0.0	0.0	1.0	1.0	0.0	1.0	1.0	0.0	0.0
Drom TA	32.052250	34.777730	11.0	0.0	2.0	0.0	1.0	0.0	10.0	0.0	1.0	0.0	...	1.0	1.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0
Hatahana	32.058245	34.762912	21.0	1.0	6.0	0.0	2.0	1.0	26.0	2.0	2.0	0.0	...	1.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kikar Hamdina	32.086852	34.789846	38.0	1.0	3.0	0.0	1.0	0.0	8.0	0.0	1.0	2.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ramat Aviv	32.108110	34.796760	19.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	1.0	2.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0

Then we can use the group by method in order to summary the most favorite restaurants type on each location:

Location	Location Latitude	Location Longitude	N1 Venue Type	N2 Venue Type	N3 Venue Type	N4 Venue Type	N5 Venue Type
Beach	32.083150	34.770640	Cafe	Mediterranean Restaurant	Sandwich Place	Italian Restaurant	Falafel Restaurant
Drom TA	32.052250	34.777730	Cafe	Mediterranean Restaurant	Diner	Italian Restaurant	Eastern European Restaurant
Hatahana	32.058245	34.762912	Mediterranean Restaurant	Cafe	Diner	Italian Restaurant	Seafood Restaurant
Kikar Hamdina	32.086852	34.789846	Cafe	Mediterranean Restaurant	Pizza Place	Italian Restaurant	Fast Food Restaurant
Ramat Aviv	32.108110	34.796760	Cafe	Mediterranean Restaurant	Pizza Place	Fast Food Restaurant	Bistro
Ramat Hahayal	32.112790	34.835230	Cafe	Mediterranean Restaurant	Fast Food Restaurant	Sandwich Place	Italian Restaurant
Rothschild	32.067307	34.778080	Cafe	Mediterranean Restaurant	Diner	Italian Restaurant	Vegetarian / Vegan Restaurant
TLV Lev	32.066132	34.783184	Cafe	Italian Restaurant	Mediterranean Restaurant	Seafood Restaurant	Japanese Restaurant

The optimal K will be determined by using the elbow method, the point where this distortion declines the most is the elbow point:



Based on the plot we select number of clusters as 3. Hence, we segment the selected Locations into three different clusters.

Now we have a visual perspective to where the new location of our restaurant can be, and we also have a clustering model which can help us find the best location, in the result section we will use this clustering model in order to find out possible locations.

5. Results

At the previous section we find out that there are only 3 Indian Restaurants available, we visualize the results in order to simplify the problem and mark them:

	Location	Location Latitude	Location Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category	Category Number
359	TLV Lev	32.066132	34.783184	Ma Pau	32.069523	34.784695	Indian Restaurant	19
424	Beach	32.083150	34.770640	Dosa Bar	32.088751	34.773720	Indian Restaurant	19
578	Drom TA	32.052250	34.777730	24 Rupee	32.053048	34.772101	Indian Restaurant	19

We also trained a clustering model in order to find our which locations have similarity; this will help us pick the best location for our new restaurant.

Our clustering results will be added to the locations DF:

Location	Location Latitude	Location Longitude	N1 Venue Type	N2 Venue Type	N3 Venue Type	N4 Venue Type	N5 Venue Type	Cluster
Beach	32.083150	34.770640	Cafe	Mediterranean Restaurant	Sandwich Place	Italian Restaurant	Seafood Restaurant	2
Drom TA	32.052250	34.777730	Cafe	Mediterranean Restaurant	Diner	Italian Restaurant	Eastern European Restaurant	0
Hatahana	32.058245	34.762912	Mediterranean Restaurant	Cafe	Diner	Italian Restaurant	Seafood Restaurant	1
Kikar Hamdina	32.086852	34.789846	Cafe	Mediterranean Restaurant	Pizza Place	Italian Restaurant	Fast Food Restaurant	2
Ramat Aviv	32.108110	34.796760	Cafe	Mediterranean Restaurant	Pizza Place	Fast Food Restaurant	Bistro	0
Ramat Hahayal	32.112790	34.835230	Cafe	Mediterranean Restaurant	Fast Food Restaurant	Sandwich Place	Italian Restaurant	0
Rothschild	32.067307	34.778080	Cafe	Mediterranean Restaurant	Vegetarian / Vegan Restaurant	Diner	Italian Restaurant	1
TLV Lev	32.066132	34.783184	Cafe	Italian Restaurant	Mediterranean Restaurant	Japanese Restaurant	Seafood Restaurant	2

Fortunately, 'Beach', 'Kikar Hamdina' and 'TLV Lev' are on the same cluster, we know that there are already restaurants in 'Beach' and 'TLV Lev' so based on this model 'Kikar Hamdina' will be a great place to open a new one!

6. Discussion

Tel Aviv is a small city with large numbers of restaurants, therefore it is highly important to select the right location for a new restaurant in order to reduce competition.

In this model we used 2 approaches in order to find the best location for a new restaurant, the first one is a visual approach which allows us to understand what are the locations of similar restaurants and to avoid misplacing of a new business.

The second approach is the clustering approach which allows to group several different areas with similar characteristics and to select the best location for a new restaurant where it is a high chance that this business will thrive.

The clustering done by using K-Means algorithm with X values, I used the elbow test in order to find the optimal K value.

In order to improve this model we can also implement the reviews or the score of each business, by doing this we will be able to understand not only the best location for new business but also the "strength" of the competitors.

7. Conclusion

The purpose of this model was to allow entrepreneurs to receive information regarding different restaurants in Tel Aviv and to help find the best location for a new one. Based on the analysis conveyed, it can be concluded that there are still opportunities in Tel Aviv for open a new restaurant with low competition. Future exploration of competitors' reviews and customers' satisfaction need to be made in order to make this model more precise.