

Determining Ideal Locations for New Restaurants in Detroit Metropolitan Area

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Introduction

- Detroit, Michigan is trying to get back on the upswing and improve as a city
- Restaurant companies could very well be looking to find a place in Detroit Metropolitan Area (DMA) to take advantage of the high population and bolster their revenues
- Increase in number of restaurants in DMA could not only allow for variety of restaurants that Detroiters can go but also increase employment to provide more jobs in DMA for those who may be unemployed
- This growth in the restaurant industry can supplement the growth of other industries in the DMA, such as tourism, as these go hand in hand

Business Problem

- Find locations in DMA that would be suitable to start a restaurant and help bolster the restaurant industry in Detroit, and also provide restaurants the chances to improve their revenue
- Target audience is not only people, such as stakeholders and investors, who are interested in opening up restaurants in DMA but also those who would be interested in opening up other types of businesses because similar analyses could be used for other businesses

Cities Considered

- Limit DMA to cities in Macomb, Oakland, and Wayne Counties
- Scraped data from websites using requests and BeautifulSoup modules to find cities in the three counties mentioned
- Then used Geopy Module in Python to get the Latitude and Longitude of each city

	City	County	City Latitude	City Longitude
0	Armada	Macomb	42.844196	-82.884372
1	Center Line	Macomb	42.485036	-83.027700
2	Clinton Township	Macomb	42.584852	-82.934824
3	Eastpointe	Macomb	42.468370	-82.955475
4	Fraser	Macomb	42.539202	-82.949365
...
53	Romulus	Wayne	42.222261	-83.396599
54	Southgate	Wayne	42.203710	-83.206756
55	Wayne	Wayne	42.268241	-83.284417
56	Westland	Wayne	42.323806	-83.400532
57	Wyandotte	Wayne	42.200662	-83.151016

58 rows x 4 columns

Venues in DMA

- One can use the latitudes and longitudes to then determine venues near those coordinates by calling the FourSquare API
- This will include lots of Venue Categories that are not really Restaurants
- Then it might be suitable to filter the data into just Venue Categories that pertain to Restaurants

Unfiltered Venue Data

	City	County	City Latitude	City Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Armada	Macomb	42.844196	-82.884372	Papa's	42.844017	-82.884001	Restaurant
1	Armada	Macomb	42.844196	-82.884372	SUBWAY	42.844247	-82.884455	Sandwich Place
2	Armada	Macomb	42.844196	-82.884372	Achatz Handmade Pie Co.	42.854847	-82.884699	Bakery
3	Armada	Macomb	42.844196	-82.884372	Tivoli's Pizza	42.844254	-82.883684	Pizza Place
4	Armada	Macomb	42.844196	-82.884372	Chap's Food & Spirits	42.844008	-82.883720	Restaurant
...
2727	Wyandotte	Wayne	42.200662	-83.151016	Vinewood Mexican Bakery	42.207565	-83.164956	Bakery
2728	Wyandotte	Wayne	42.200662	-83.151016	Joe's Corner Store	42.201436	-83.168071	Convenience Store
2729	Wyandotte	Wayne	42.200662	-83.151016	Kielbasa Joe's	42.204145	-83.167687	Butcher
2730	Wyandotte	Wayne	42.200662	-83.151016	Cahalan Liquor & Party Store	42.199967	-83.168691	Liquor Store
2731	Wyandotte	Wayne	42.200662	-83.151016	The Pasta House	42.207219	-83.167102	Italian Restaurant

2732 rows × 8 columns

Filtered Venue Data

	City	County	City Latitude	City Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Armada	Macomb	42.844196	-82.884372	Papa's	42.844017	-82.884001	Restaurant
1	Armada	Macomb	42.844196	-82.884372	SUBWAY	42.844247	-82.884455	Sandwich Place
2	Armada	Macomb	42.844196	-82.884372	Tivoli's Pizza	42.844254	-82.883684	Pizza Place
3	Armada	Macomb	42.844196	-82.884372	Chap's Food & Spirits	42.844008	-82.883720	Restaurant
4	Center Line	Macomb	42.485036	-83.027700	Pauluke's Grill	42.482994	-83.027071	American Restaurant
...
978	Wyandotte	Wayne	42.200662	-83.151016	SUBWAY	42.209797	-83.147658	Sandwich Place
979	Wyandotte	Wayne	42.200662	-83.151016	Big Boy Restaurant	42.199199	-83.151626	American Restaurant
980	Wyandotte	Wayne	42.200662	-83.151016	Wendy's	42.198147	-83.152044	Fast Food Restaurant
981	Wyandotte	Wayne	42.200662	-83.151016	McDonald's	42.198504	-83.150767	Fast Food Restaurant
982	Wyandotte	Wayne	42.200662	-83.151016	The Pasta House	42.207219	-83.167102	Italian Restaurant

983 rows x 8 columns

Methodology

- Needed to convert the Venue Categories into something more tenable, namely not categorical; used One-Hot Encoding
- Then needed to create a proportion data frame representing proportion of a given venue per city
- Afterwards created a top ten venue list in each city
- Did this for both the Unfiltered and Filtered Venue Data; will show the data for Unfiltered Data, as Filtered Data would be analogous

One-Hot Encoding for Unfiltered Venue Data

	City	County	City Latitude	City Longitude	Venue	Venue Latitude	Venue Longitude	...	Winery	Wings Joint	Women's Store	Yemeni Restaurant	Yoga Studio	Zoo	Zoo Exhibit
0	Armada	Macomb	42.844196	-82.884372	Papa's	42.844017	-82.884001	...	0	0	0	0	0	0	0
1	Armada	Macomb	42.844196	-82.884372	SUBWAY	42.844247	-82.884455	...	0	0	0	0	0	0	0
2	Armada	Macomb	42.844196	-82.884372	Achatz Handmade Pie Co.	42.854847	-82.884699	...	0	0	0	0	0	0	0
3	Armada	Macomb	42.844196	-82.884372	Tivoli's Pizza	42.844254	-82.883684	...	0	0	0	0	0	0	0
4	Armada	Macomb	42.844196	-82.884372	Chap's Food & Spirits	42.844008	-82.883720	...	0	0	0	0	0	0	0
...
2727	Wyandotte	Wayne	42.200662	-83.151016	Vinewood Mexican Bakery	42.207565	-83.164956	...	0	0	0	0	0	0	0
2728	Wyandotte	Wayne	42.200662	-83.151016	Joe's Corner Store	42.201436	-83.168071	...	0	0	0	0	0	0	0
2729	Wyandotte	Wayne	42.200662	-83.151016	Kielbasa Joe's	42.204145	-83.167687	...	0	0	0	0	0	0	0
2730	Wyandotte	Wayne	42.200662	-83.151016	Cahalan Liquor & Party Store	42.199967	-83.168691	...	0	0	0	0	0	0	0
2731	Wyandotte	Wayne	42.200662	-83.151016	The Pasta House	42.207219	-83.167102	...	0	0	0	0	0	0	0

2732 rows × 300 columns

Proportional DataFrame for Unfiltered Venue Data

	City	County	Accessories Store	Adult Boutique	Airport	Airport Service	American Restaurant	...	Winery	Wings Joint	Women's Store	Yemeni Restaurant	Yoga Studio	Zoo	Zoo Exhibit
0	Allen Park	Wayne	0.0	0.000000	0.0	0.0	0.086957	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
1	Armada	Macomb	0.0	0.000000	0.0	0.0	0.000000	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
2	Auburn Hills	Oakland	0.0	0.000000	0.0	0.0	0.090909	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
3	Bloomfield Hills	Oakland	0.0	0.000000	0.0	0.0	0.000000	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
4	Center Line	Macomb	0.0	0.000000	0.0	0.0	0.054545	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
...
53	Walled Lake	Oakland	0.0	0.000000	0.0	0.0	0.025641	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
54	Wayne	Wayne	0.0	0.021277	0.0	0.0	0.000000	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
55	Westland	Wayne	0.0	0.000000	0.0	0.0	0.015625	...	0.0	0.015625	0.0	0.0	0.0	0.0	0.0
56	Wixom	Oakland	0.0	0.000000	0.0	0.0	0.024390	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0
57	Wyandotte	Wayne	0.0	0.000000	0.0	0.0	0.034483	...	0.0	0.000000	0.0	0.0	0.0	0.0	0.0

58 rows × 294 columns

Top Ten DataFrame for Unfiltered Venue Data

	City	County	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Allen Park	Wayne	American Restaurant	Pizza Place	Fast Food Restaurant	Taco Place	Italian Restaurant	Bank	Pharmacy	Discount Store	Diner	Deli / Bodega
1	Armada	Macomb	Restaurant	Bar	Sandwich Place	Hardware Store	Ice Cream Shop	Bakery	Pizza Place	Trail	Farmers Market	Fast Food Restaurant
2	Auburn Hills	Oakland	Pizza Place	American Restaurant	Chinese Restaurant	Intersection	Thai Restaurant	Sports Bar	Mexican Restaurant	Mobile Phone Shop	Brewery	Frozen Yogurt Shop
3	Bloomfield Hills	Oakland	Hotel	Bank	Bagel Shop	Construction & Landscaping	Greek Restaurant	Spa	Seafood Restaurant	Deli / Bodega	Intersection	Science Museum
4	Center Line	Macomb	Park	Intersection	American Restaurant	Bar	Ice Cream Shop	Discount Store	Diner	Pharmacy	Dessert Shop	Liquor Store
...
53	Walled Lake	Oakland	Fast Food Restaurant	Sandwich Place	Bar	Bowling Alley	Toy / Game Store	Beach	Cosmetics Shop	Gym / Fitness Center	Grocery Store	Ice Cream Shop
54	Wayne	Wayne	Pizza Place	Fast Food Restaurant	Pharmacy	Grocery Store	Liquor Store	Hardware Store	Video Store	Bakery	Ice Cream Shop	Convenience Store
55	Westland	Wayne	Coffee Shop	Pizza Place	Mexican Restaurant	Discount Store	Diner	Fast Food Restaurant	Ice Cream Shop	Sandwich Place	Liquor Store	Video Game Store
56	Wixom	Oakland	Pizza Place	Sandwich Place	Park	Gym / Fitness Center	Bank	Restaurant	Post Office	Brewery	Soccer Field	Skating Rink
57	Wyandotte	Wayne	Italian Restaurant	Bar	Convenience Store	Sandwich Place	Whisky Bar	Fast Food Restaurant	Sports Bar	Mexican Restaurant	American Restaurant	Art Gallery

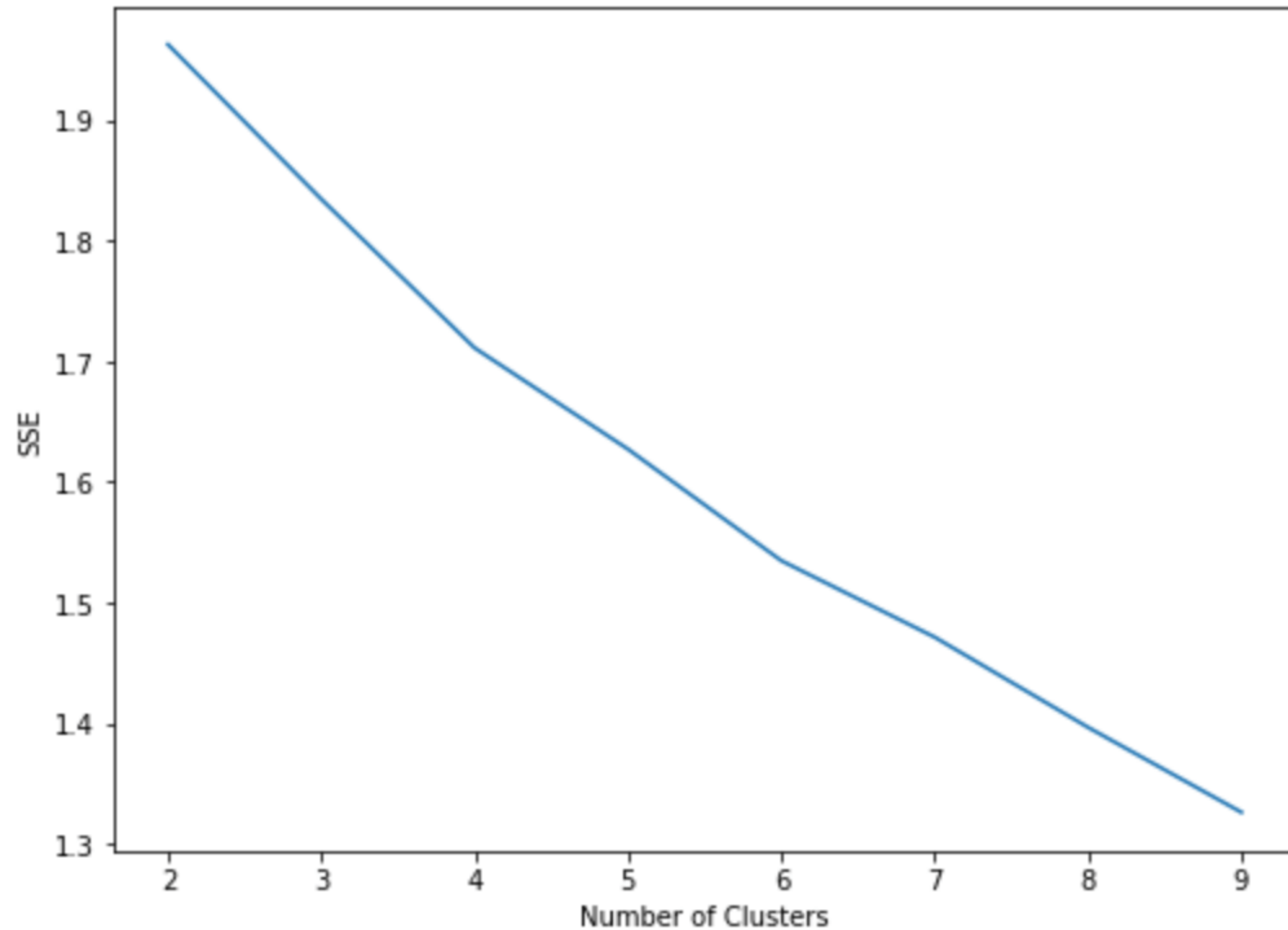
58 rows × 12 columns

K-Means Clustering

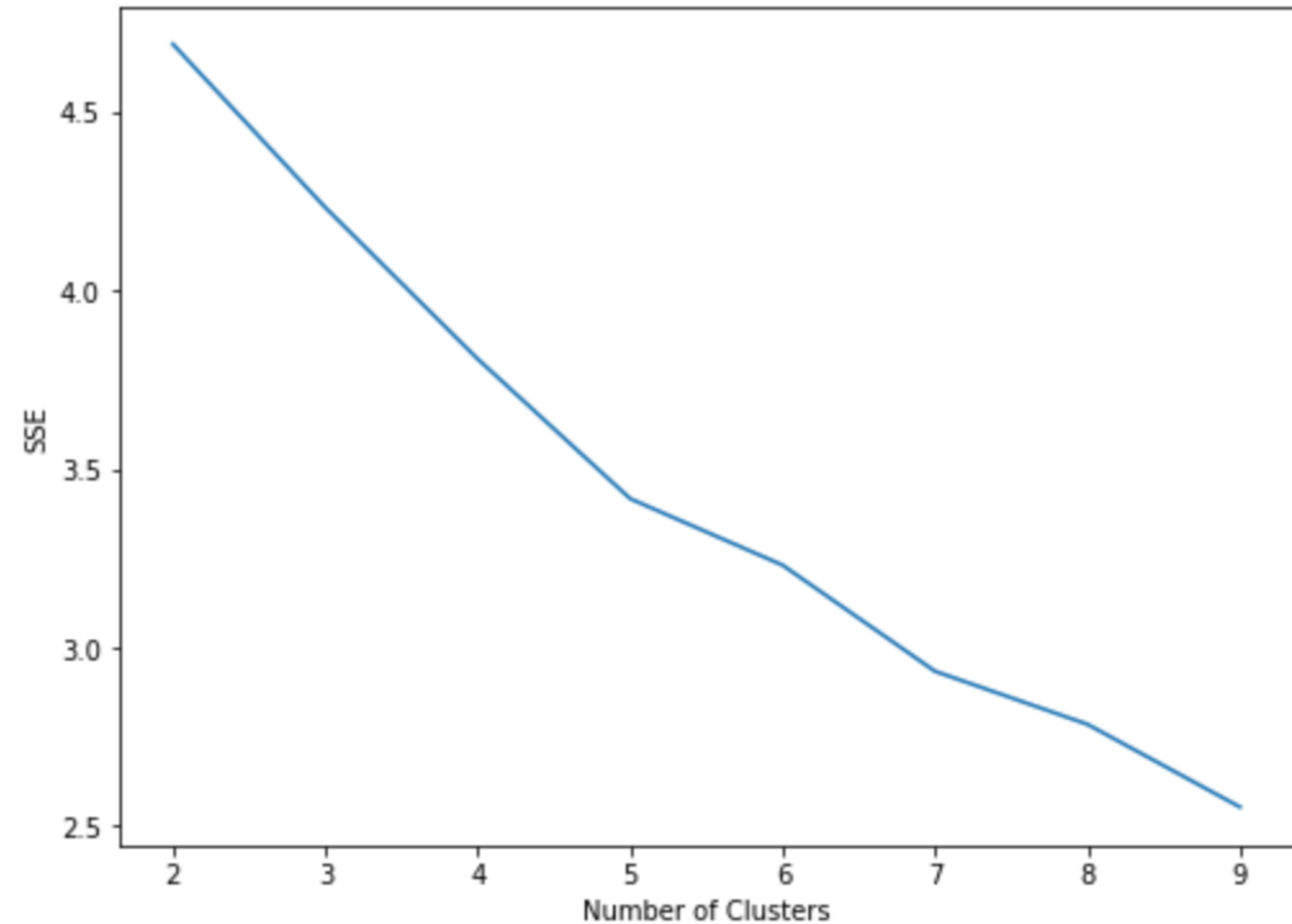
- Using proportion dataframe, one can view each row as an example of a city's data showing the proportion of all the venues
- These examples can be processed by k-means clustering, where examples are closer together based on similarity between their proportions
- Can use the elbow method to determine ideal number of clusters to break the data into; determined for both unfiltered and filtered data we have six clusters is optimal number

Elbow Method on Venue Data

Number of Clusters vs SSE for Unfiltered Data



Number of Clusters vs SSE for Filtered Data



Clustering DataFrames

- We can determine the cluster number after K-Means Clustering applied to both Filtered and Unfiltered Data for each city
- This can then be appended to the Top Ten DataFrame and then each individual cluster can get its own dataframe showing all the cities within each cluster
- Will display only for Unfiltered Data as Filtered Data would be analogous; also will only choose one sample cluster within Unfiltered Data
- Can then plot the clusters on a map, where same color indicates same cluster; will do this only with Unfiltered Data, as Filtered Data would be analogous

Unfiltered Venue Data with Cluster Number

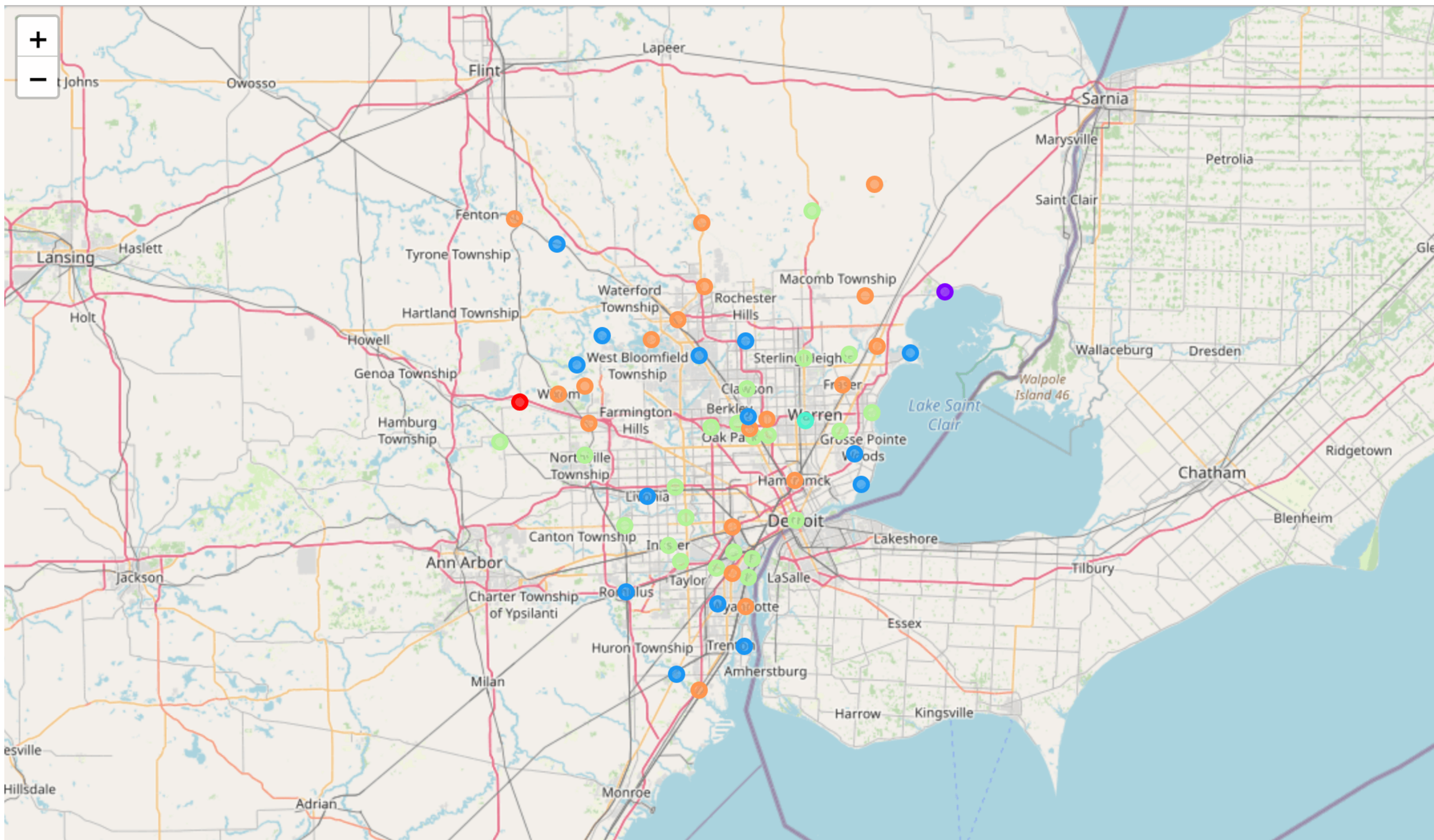
	City	County	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue	Cluster Number
0	Allen Park	Wayne	American Restaurant	Pizza Place	Fast Food Restaurant	Taco Place	Italian Restaurant	Bank	Pharmacy	Discount Store	Diner	Deli / Bodega	4
1	Armada	Macomb	Restaurant	Bar	Sandwich Place	Hardware Store	Ice Cream Shop	Bakery	Pizza Place	Trail	Farmers Market	Fast Food Restaurant	2
2	Auburn Hills	Oakland	Pizza Place	American Restaurant	Chinese Restaurant	Intersection	Thai Restaurant	Sports Bar	Mexican Restaurant	Mobile Phone Shop	Brewery	Frozen Yogurt Shop	3
3	Bloomfield Hills	Oakland	Hotel	Bank	Bagel Shop	Construction & Landscaping	Greek Restaurant	Spa	Seafood Restaurant	Deli / Bodega	Intersection	Science Museum	3
4	Center Line	Macomb	Park	Intersection	American Restaurant	Bar	Ice Cream Shop	Discount Store	Diner	Pharmacy	Dessert Shop	Liquor Store	4
...
53	Walled Lake	Oakland	Fast Food Restaurant	Sandwich Place	Bar	Bowling Alley	Toy / Game Store	Beach	Cosmetics Shop	Gym / Fitness Center	Grocery Store	Ice Cream Shop	1
54	Wayne	Wayne	Pizza Place	Fast Food Restaurant	Pharmacy	Grocery Store	Liquor Store	Hardware Store	Video Store	Bakery	Ice Cream Shop	Convenience Store	1
55	Westland	Wayne	Coffee Shop	Pizza Place	Mexican Restaurant	Discount Store	Diner	Fast Food Restaurant	Ice Cream Shop	Sandwich Place	Liquor Store	Video Game Store	3
56	Wixom	Oakland	Pizza Place	Sandwich Place	Park	Gym / Fitness Center	Bank	Restaurant	Post Office	Brewery	Soccer Field	Skating Rink	3
57	Wyandotte	Wayne	Italian Restaurant	Bar	Convenience Store	Sandwich Place	Whisky Bar	Fast Food Restaurant	Sports Bar	Mexican Restaurant	American Restaurant	Art Gallery	4

Cluster 1 with Unfiltered Venue Data

	City	County	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue	Cluster Number
5	Clawson	Oakland	Pizza Place	Fast Food Restaurant	Sandwich Place	Video Store	Pharmacy	Convenience Store	Bar	Fried Chicken Joint	Intersection	Greek Restaurant	1
13	Ecorse	Wayne	Discount Store	Mexican Restaurant	Fast Food Restaurant	Intersection	Pharmacy	Burger Joint	Gastropub	Grocery Store	Bank	Liquor Store	1
15	Flat Rock	Wayne	Fast Food Restaurant	Burger Joint	Ice Cream Shop	Pharmacy	Diner	Pet Store	Bank	Sandwich Place	Dairy Store	Gas Station	1
16	Fraser	Macomb	Pizza Place	American Restaurant	Sandwich Place	Pharmacy	Cosmetics Shop	Mexican Restaurant	Fast Food Restaurant	Bar	Bank	Construction & Landscaping	1
28	Lincoln Park	Wayne	Pizza Place	Fast Food Restaurant	Mexican Restaurant	Ice Cream Shop	Diner	Mobile Phone Shop	Pharmacy	Discount Store	Fried Chicken Joint	Coffee Shop	1
...
42	Rockwood	Wayne	Pizza Place	Bar	American Restaurant	Sandwich Place	Grocery Store	Market	Intersection	Pharmacy	Pet Store	Convenience Store	1
44	Romulus	Wayne	Sandwich Place	Fast Food Restaurant	Pizza Place	Electronics Store	Train Station	Bar	Park	Gym / Fitness Center	Intersection	Gas Station	1
47	South Lyon	Oakland	Fast Food Restaurant	Pizza Place	Ice Cream Shop	Gym	Pharmacy	Restaurant	Sandwich Place	Brewery	American Restaurant	Discount Store	1
53	Walled Lake	Oakland	Fast Food Restaurant	Sandwich Place	Bar	Bowling Alley	Toy / Game Store	Beach	Cosmetics Shop	Gym / Fitness Center	Grocery Store	Ice Cream Shop	1
54	Wayne	Wayne	Pizza Place	Fast Food Restaurant	Pharmacy	Grocery Store	Liquor Store	Hardware Store	Video Store	Bakery	Ice Cream Shop	Convenience Store	1

14 rows x 13 columns

Map of Clusters



Discussion

- Assume that it is good to build a restaurant in an area where other restaurants of similar types are located, as that would eventually attract people to come to the new restaurant, since they would want to try this restaurant's food
- Then, one can determine which cluster is most similar to the restaurant, and then determine which cities may be best to build the restaurant.
- Turns out that some clusters have a preponderance of restaurants in the top ten when using unfiltered data; then looking at the filtered restaurants, we see that one cluster favors Fast Food Restaurants, another favors American Restaurant and Pizza Places, and a third cluster favors ethnic diversity in the cities' restaurants
- No geographical basis for the clustering, which shows various cuisines in DMA are spread out

Conclusion

- Project attempt to find ways of determining where restaurant can be created in Detroit Metropolitan Area, under the assumption one is looking for similar restaurants to draw customers from
- K-Means Clustering algorithm was used to determine this similarity measure, and was used on both filtered venue data that only considers restaurants as venue category, and unfiltered venue data that considers all types of venue categories
- Project only uses venues within a mile of a specified latitude and longitude of a city to characterize a city; perhaps a different distance would do a better job
- One-hot encoding used for the project indicates that there are lots of specific descriptions, so maybe better to group specific categories into general categories

Conclusion (Continued)

- Project assumes that there is enough profit that will be generated to keep the new restaurant in the air; should possibly consider competition from similar restaurants and operational costs of working within a city
- All these ideas and many more that businesses place in high importance can be considered in future research and would lead to different models being used