

# **Segmenting and Clustering Towns in Massachusetts Based on Venues**

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## **1. Introduction**

### **1.1 Background**

Massachusetts is the fifteenth most populous state in the United States. It is also home to over one hundred colleges and universities including Harvard University, MIT, Tufts University, and my own undergraduate college, Bentley University. Many college students end up residing in Massachusetts after completing their education. Therefore, it would be useful information to understand the many towns of Massachusetts and their venues when figuring out the most ideal town to live in.

### **1.2 Problem**

This project aims to segment and cluster similar towns based on venues in Massachusetts. The types of venues that are frequented the most in each town are used to cluster towns with one another. The project will locate towns that are similar to other towns and their amenities to allow for a more informed decision on where to move to or stay.

## **2. Data acquisition and cleaning**

### **2.1 Data sources**

The list of towns in Massachusetts was scraped from a [Wikipedia page](#) for a total of 351 towns. The list of latitude and longitude points of the state and each town were found through the Google Maps Geocoding API. The venues within a 500-meter radius of each town were found through the Foursquare API.

### **2.2 Data cleaning**

The data scraped from the Wikipedia page was prepared by removing missing values. Those missing values were associated with rows that were not classified as towns or cities, thus insignificant to the goal of the project and removed. The column heading containing towns was changed from “Municipality” to “Neighborhood” to allow for more ease in merging the venue information from Foursquare to the main dataframe. Additional columns in the dataframe are added including the state, to be used in the creation of a map, as well as the latitude and longitude, to be used to get the nearby venues of each town.

## **3. Methodology**

### **3.1 Exploratory data analysis**

The location of each town is denoted by its latitude and longitude. Using its latitude and longitude, a map of Massachusetts, Figure 1, is created and each town is marked.

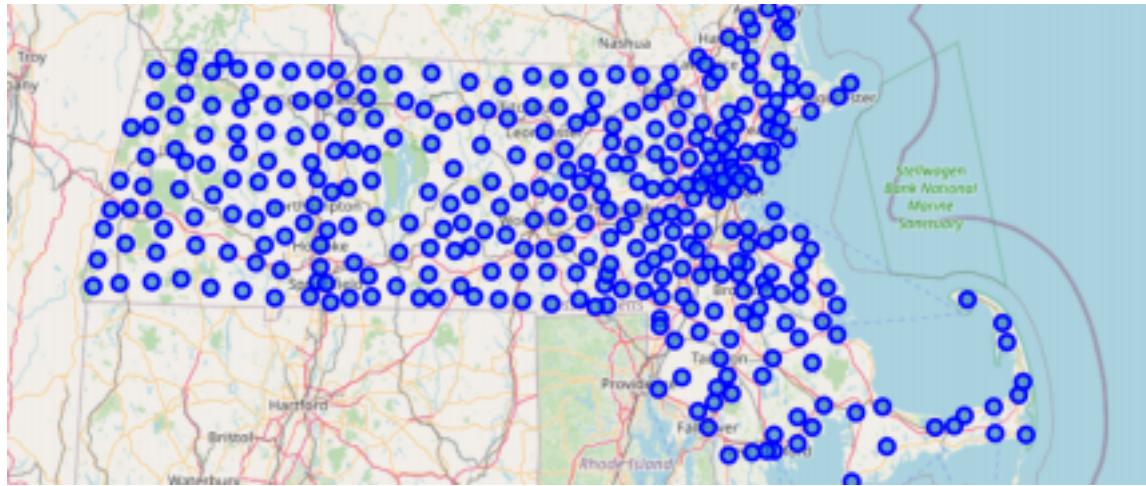


Figure 1. Map of the towns.

### 3.2 K-means clustering

To figure out the optimal number of clusters to use, the elbow method is used to visualize and evaluate the best value of k. The k is chosen where the graph bends at the “elbow” where the distortion and inertia decrease. As seen from figures 2, and 3, there is no clear elbow, but the graph does tend to decrease at the value of 6, so the optimal number of clusters to use is 6.

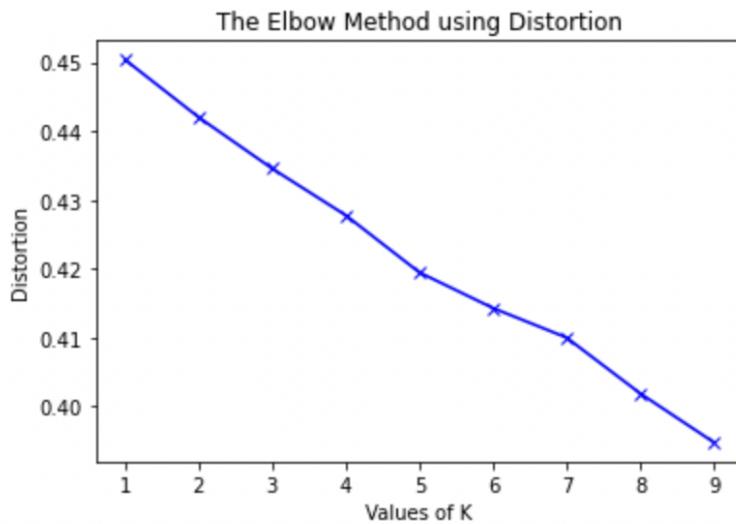


Figure 2. Elbow method using distortion visualization.

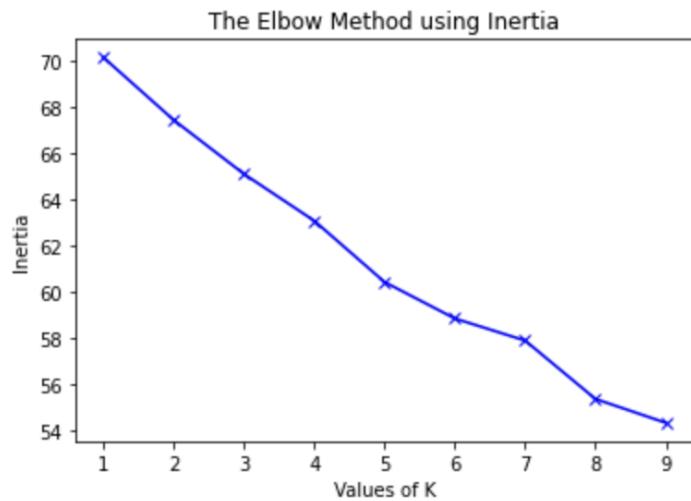


Figure 3. Elbow method using inertia visualization.

The k-means clustering method is used as an unsupervised machine learning to segment towns based on their top 10 most frequented venues. The venues are organized by their venue category and the frequency of occurrence in each category by town is averaged. Using the venues, each town is assigned one of the six clusters.

## 4. Results

The resulting six clusters are shown in Figures 4-9.

Neighborhood	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	
3	Carlisle	Post Office	Sandwich Place	Park	Women's Store	Event Service	Donut Shop	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store
27	Bolton	Park	Playground	Performing Arts Venue	Women's Store	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
36	Stow	Park	Weight Loss Center	Pizza Place	American Restaurant	Women's Store	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant
53	Reading	Pool	Park	Playground	Brewery	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
54	North Andover	Playground	Basketball Court	Ice Cream Shop	American Restaurant	Tree	Park	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant
90	Newbury	Butcher	Home Service	Park	Women's Store	Event Space	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
95	Burlington	Park	Pizza Place	Gas Station	Disc Golf	Baseball Field	Playground	Fish & Chips Shop	Event Service	Dry Cleaner	Eastern European Restaurant
110	New Ashford	American Restaurant	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit

154	Mattapoisett	Seafood Restaurant	Market	Harbor / Marina	Bar	Park	Event Space	Donut Shop	Drugstore	Dry Cleaner	Eastern European Restaurant
159	Hampden	Post Office	Park	Italian Restaurant	Dog Run	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
165	Charlton	Park	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant
209	Bourne	Park	Post Office	Pharmacy	Bar	Women's Store	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant
225	Swansea	Construction & Landscaping	Park	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant
242	Freetown	Convenience Store	Park	Donut Shop	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
254	Somerset	Baseball Field	Harbor / Marina	Park	History Museum	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
262	Granby	Food	Farm	Restaurant	Park	Women's Store	Event Service	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store
275	Bernardston	Ski Chalet	Park	Women's Store	Dog Run	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
278	Oak Bluffs	Bar	Art Gallery	Park	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
286	Oxford	American Restaurant	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
327	Palmer	Park	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant

Figure 4. Cluster 1

Neighborhood	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	
56	Wenham	Breakfast Spot	History Museum	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
120	Plympton	Post Office	Breakfast Spot	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
123	West Bridgewater	Breakfast Spot	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
289	Russell	Breakfast Spot	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit

Figure 5. Cluster 2

Neighborhood		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
4	Sherborn	Convenience Store	Pizza Place	Business Service	Sandwich Place	Donut Shop	Women's Store	Event Service	Dry Cleaner	Eastern European Restaurant	Electronics Store
74	Medway	Convenience Store	Pizza Place	Business Service	Nightclub	Playground	Plaza	Event Service	Drugstore	Dry Cleaner	Eastern European Restaurant
117	Hopedale	Convenience Store	Antique Shop	Liquor Store	Falafel Restaurant	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
134	Rochester	Baseball Field	Convenience Store	American Restaurant	Falafel Restaurant	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
139	Pembroke	Convenience Store	Pharmacy	Donut Shop	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
146	Brimfield	Convenience Store	Pizza Place	Farmers Market	Flea Market	Fish Market	Fishing Spot	Fish & Chips Shop	Financial or Legal Service	Fast Food Restaurant	Fishing Store
148	Eastham	Convenience Store	Antique Shop	Grocery Store	Liquor Store	Park	Women's Store	Event Space	Dry Cleaner	Eastern European Restaurant	Electronics Store
187	Sheffield	Convenience Store	Bookstore	Furniture / Home Store	Women's Store	Falafel Restaurant	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
217	Hanson	Convenience Store	Ice Cream Shop	New American Restaurant	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
227	Avon	Convenience Store	American Restaurant	Lake	Pizza Place	Financial or Legal Service	Bar	Liquor Store	Event Space	Eastern European Restaurant	Electronics Store
247	Petersham	Scenic Lookout	Convenience Store	Dog Run	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
287	Milville	Post Office	Bar	Pizza Place	Convenience Store	Home Service	Doctor's Office	Donut Shop	Drugstore	Dry Cleaner	Eastern European Restaurant
321	Taunton	Convenience Store	Exhibit	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant

Figure 6. Cluster 3

Neighborhood		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
9	Boxford	Shop & Service	Farm	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
10	Wayland	Home Service	Pharmacy	Salon / Barbershop	Chinese Restaurant	Thai Restaurant	Women's Store	Ethiopian Restaurant	Donut Shop	Drugstore	Dry Cleaner
14	Newton	Brewery	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
19	Lincoln	Museum	Farm	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space

20	Boxborough	Bakery	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
28	Alford	IT Services	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
30	Longmeadow	Pub	Women's Store	Exhibit	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
35	West Newbury	Italian Restaurant	Baseball Field	Playground	Women's Store	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
43	Westford	Bakery	Home Service	History Museum	Farmers Market	Exhibit	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant
45	Scituate	Intersection	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
46	Chelmsford	Rest Area	Exhibit	Business Service	Women's Store	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
58	Milton	Home Service	Convenience Store	Grocery Store	Park	Women's Store	Event Space	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant
62	Ashland	Gastropub	Playground	Home Service	Post Office	Pizza Place	Miscellaneous Shop	Breakfast Spot	Bagel Shop	Italian Restaurant	Gym
63	Nahant	Post Office	Beach	Business Service	Event Service	Exhibit	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Space	Falafel Restaurant
64	Marion	Business Service	Tennis Court	Athletics & Sports	Convenience Store	Post Office	Sandwich Place	Harbor / Marina	Drugstore	Dry Cleaner	Eastern European Restaurant
71	Berlin	Construction & Landscaping	Antique Shop	Business Service	Performing Arts Venue	Deli / Bodega	Bank	Event Space	Dry Cleaner	Eastern European Restaurant	Electronics Store
81	Walpole	Bar	Baseball Field	Post Office	Home Service	Pizza Place	Soccer Field	Event Service	Donut Shop	Drugstore	Dry Cleaner
83	Upton	Hunting Supply	Business Service	Martial Arts School	Restaurant	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
87	Essex	Cocktail Bar	Post Office	Harbor / Marina	Antique Shop	Seafood Restaurant	Wine Bar	Financial or Legal Service	Event Service	Donut Shop	Drugstore
92	Mendon	Pool	Mediterranean Restaurant	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
97	Tyngsborough	Golf Course	Lake	River	Bar	Event Service	Donut Shop	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store
98	Holden	Dog Run	Exhibit	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant
105	Grafton	Flower Shop	Bar	Sandwich Place	Athletics & Sports	Baseball Field	Playground	Fish & Chips Shop	Event Service	Drugstore	Dry Cleaner
111	Truro	Bakery	Liquor Store	Business Service	New American Restaurant	Post Office	Fish & Chips Shop	Financial or Legal Service	Fast Food Restaurant	Farmers Market	Farm
127	Danvers	Home Service	Bike Trail	Moving Target	Women's Store	Falafel Restaurant	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
128	Conway	Post Office	Bar	Baseball Field	Farmers Market	Exhibit	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
133	Wilmington	Automotive Shop	Sporting Goods Shop	Gym	Bakery	Creperie	Drugstore	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service

135	Kingston	River	Baseball Field	Playground	Museum	Women's Store	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
138	Rehoboth	Business Service	Athletics & Sports	Historic Site	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
144	Douglas	Home Service	Women's Store	Exhibit	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
153	Deerfield	River	Dog Run	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit
161	Williamsburg	Brewery	Post Office	Food & Drink Shop	Furniture / Home Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service
175	Paxton	Playground	Women's Store	Falafel Restaurant	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Exhibit

Figure 7. Cluster 4

Neighborhood	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	
34	Richmond	Business Service	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant
96	Hull	Scenic Lookout	Business Service	Women's Store	Donut Shop	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
156	Lunenburg	Scenic Lookout	Women's Store	Dog Run	Drugstore	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
201	Ashburnham	Business Service	Bed & Breakfast	Women's Store	Exhibit	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant
270	South Hadley	Business Service	Yoga Studio	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant
297	Buckland	Business Service	Women's Store	Exhibit	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space	Falafel Restaurant

Figure 8. Cluster 5

Neighborhood	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	Weston	Pizza Place	Pharmacy	Coffee Shop	Diner	Peking Duck Restaurant	Market	Women's Store	Event Space	Dry Cleaner	Eastern European Restaurant
1	Dover	Post Office	Donut Shop	Grocery Store	Deli / Bodega	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
2	Lexington	Italian Restaurant	Ice Cream Shop	Bank	Bakery	Coffee Shop	History Museum	Women's Store	Pizza Place	Shop & Service	Shoe Store
5	Sudbury	Yoga Studio	Italian Restaurant	Pizza Place	Donut Shop	Dry Cleaner	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
6	Wellesley	Coffee Shop	Pizza Place	Italian Restaurant	Thai Restaurant	Clothing Store	Mediterranean Restaurant	Yoga Studio	Pet Store	Shopping Mall	Café
...	...	...	...	...	...	...	...	...	...	...	...
347	New Bedford	Fast Food Restaurant	Breakfast Spot	American Restaurant	Art Gallery	Farm	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Event Service	Event Space
348	Chelsea	Pharmacy	Plaza	Arts & Crafts Store	Fast Food Restaurant	Liquor Store	Electronics Store	Donut Shop	Discount Store	Bank	Bagel Shop
349	Holyoke	Pizza Place	Spanish Restaurant	Art Gallery	Bar	Café	Bakery	Storage Facility	Trail	Science Museum	Park
351	Springfield	American Restaurant	Hockey Arena	Café	Hotel	Shipping Store	Middle Eastern Restaurant	Donut Shop	Pizza Place	Coffee Shop	Sculpture Garden
352	Lawrence	Caribbean Restaurant	Donut Shop	Spanish Restaurant	Bank	Pizza Place	Pharmacy	Pub	Café	Shoe Store	Fast Food Restaurant

160 rows × 11 columns

Figure 9. Cluster 6

A map of the resulting clusters is shown in Figure 10.

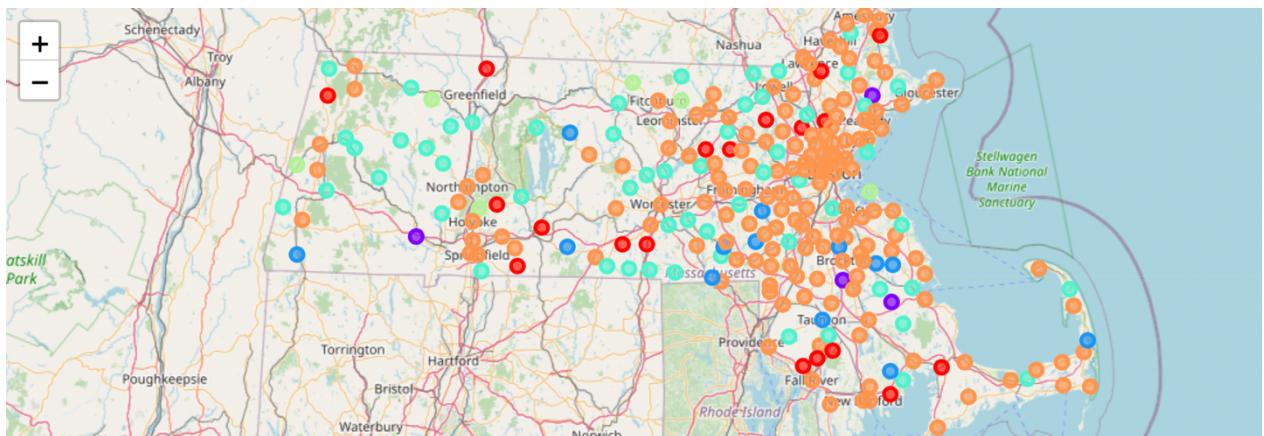


Figure 10. Map of clusters.

## **5. Discussion**

The towns within each cluster have similar frequented venues. As discussed in the data cleaning, some towns were omitted because of the lack of data from Foursquare on frequented venues.

Cluster 1 consists of twenty towns. The towns are denoted with red markers in Figure 10. The most frequented venues for Cluster 1 include the park, playground, and women stores. Cluster 2's most frequented spots are breakfast spots, falafel and Eastern Ethiopian restaurants, dry cleaners, and event spaces. The four towns that make up this cluster have very similar ranked frequented venues, denoted by the purple markers in Figure 10. In Cluster 3, the most popular spot is the convenience store. The thirteen towns in this cluster are marked using blue markers in Figure 10. Cluster 4 consists of 59 towns. These towns are marked with a bright aqua blue in Figure 10. The towns in Cluster 5 are shown in Figure 10 as the light mint green markers. It is characterized with business service, women's store, and scenic lookout as its most frequented venues. Cluster 6 is denoted by the orange markers that mark the location of the 110 towns in the cluster. The towns are mainly concentrated in the east of Massachusetts. The larger clusters such as Cluster 4 and 6 have more of a mix in the types of venues most visited compared to that of the smaller clusters that have more specific frequented venues.

## **6. Conclusion**

For Massachusetts residents who are looking to move, it may be helpful to see which town is similar in venues to their ideal location, especially if they are looking to go somewhere similar but cheaper in cost of living. The results can also be used to find towns that are not as similar to their current location as well. With other factors that may be associated with choosing a town to live in, it may also be beneficial for another project to assess cost of living, job prospects, safety, and more for each town.