Finding Optimal Location for BBQ in Austin Texas

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1 Introduction

1.1 Background

Opening a restaurant is a high-risk business venture. Around 60% of new ventures fail in the first year and 80% fail by their fifth anniversary.[1] Choosing the right location is critical to the ultimate success of the venture. Therefore the question becomes in a city the size of ~769 land square kilometers and ~978,000 people, how do you build an initial list of potential restaurant locations?

1.2 Business Problem

In this project we will try to find a list optimal locations for a restaurant. Specifically, this report will be targeted to stakeholders interested in opening an Barbecue (BBQ) in Austin Texas, United States of America.

Since there are a lot of restaurants in Austin Texas the goal is to detect locations that are not already crowded with restaurants. The stakeholders are also particularly interested in areas with no BBQ restaurants in vicinity. Final, locations as close to city center as possible are preferred, assuming that first two conditions are met.

Data science is used to generate a few most promising neighborhoods based on this criteria. Advantages of each area will then be clearly expressed so that best possible final location can be chosen by stakeholders.

1.3 Interest

The owners looking to open then new Barbecue restaurant are interested in the results of this analysis to begin determining possible locations for their business. In addition, the investment partners and lending institutions are also interested in this analysis to determine the risk of any investment/loan to this new venture.

2 Data

2.1 Data Source

Based on the definition of our problem, factors that were used to influence the decision are:

- number of existing restaurants in the neighborhood (any type of restaurant)
- number of and distance to BBQ restaurants in the neighborhood, if any
- distance of neighborhood from city center

It was decided to use regularly spaced grid of locations, centered around city center, to define potential neighborhoods.

Following data sources were needed to extract/generate the required information:

[1] Statistics from CNBC article "The No. 1 things to consider before opening a restaurant" by Jarrett Bellini.

- coordinate of Austin center was obtained using MapQuest API geocoding of well known Austin Texas location (Texas State Capital)
- centers of candidate areas were generated algorithmically and approximate addresses of centers of those areas were obtained using MapQuest API reverse geocoding.
- number of restaurants, their type and location in every neighborhood were obtained using Foursquare API

2.2 Data Acquisition

2.2.1 Neighborhood Candidates

It was decided to designate the Texas State Capitol as the center of Austin Texas. Candidate neighborhoods were determined by creating a grid of cells covering an area of approximately 12x12 kilometers from this center point.

The grid area of candidates calculated were equally spaced around the city center and within approximately 6 kilometers from the Texas State Capitol.. To accurately calculate distances, the grid of locations were calculated in Cartesian 2D coordinate system which allows us to calculate distances in meters (not in latitude/longitude degrees). Neighborhoods candidates are defined as circular areas with a radius of 300 meters, so the neighborhood centers are 600 meters apart. Using this, a hexagonal grid of cells was made. Each row was offset from every other row, and the vertical row spacing was adjusted so that every cell center is equally distant from all its neighbors (Figure 1).

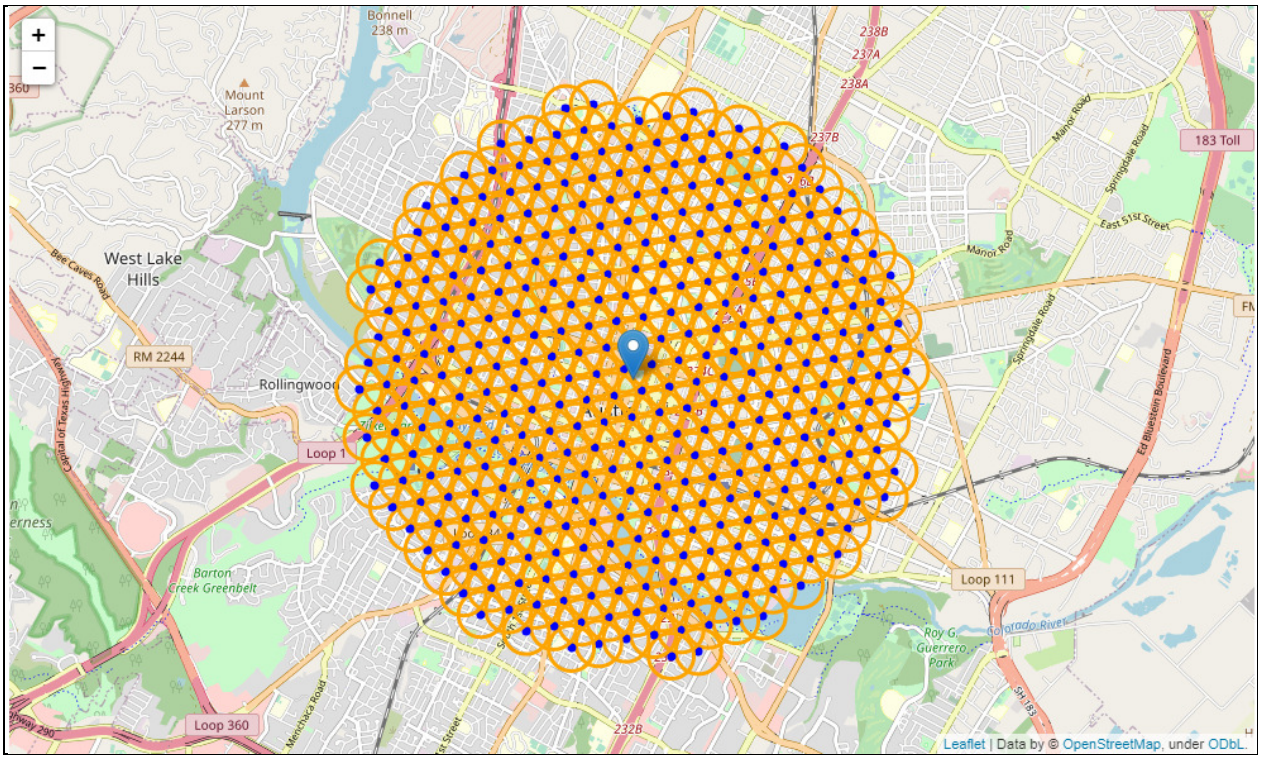

Figure 1: Map of Candidate Neighborhoods centered around the Texas State Capitol

The approximate addresses of centers of these areas were then obtained using the MapQuest API reverse geocoding.

2.2.2 Foursquare

The Foursquare API is used retrieve the restaurant venues in the candidate neighborhoods. The results were filtered to remove those in the 'food' category that were determined not to be direct competitors (coffee shops, pizza places, bakeries, etc.). The remaining results were added to a table for further analysis. Additionally, all restaurant venues designated as members of the 'BBQ joint' category were marked for further analysis.[2] This ensured all the restaurants in area within few kilometers from the Texas State Capitol are included for analysis and the Barbecue (BBQ) restaurants are highlighted. Additionally, the data also designates which restaurants exactly are in vicinity of every neighborhood candidate center.

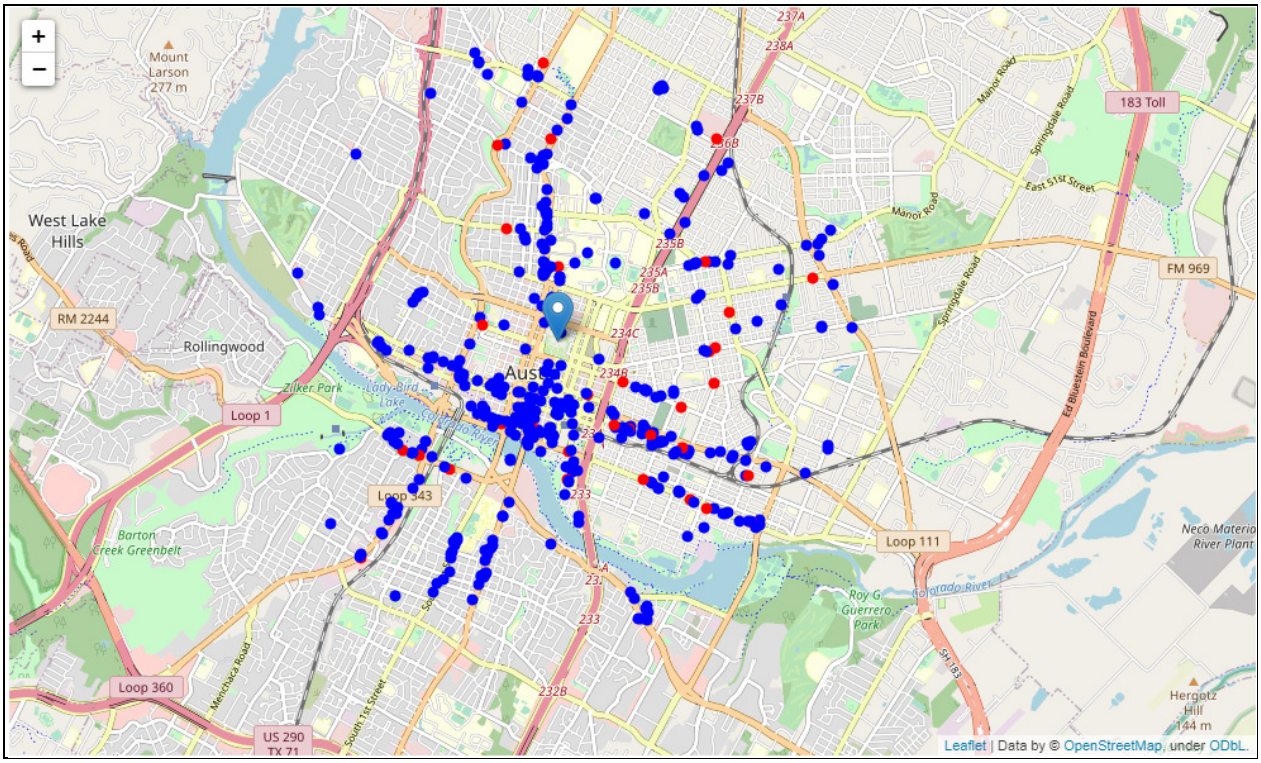

Figure 2: Map of Restaurants (blue) and Barbecue Restaurants (red) centered around the Texas State Capitol

3 Methodology

In this project the goal was to detect areas of Austin Texas that have low restaurant density, particularly those with low number of BBQ restaurants. The analysis was limited an area ~6km around city center.

Therefore the initial exploratory data analysis was a calculation and exploration of 'restaurant density' across the city center of Austin Texas. Heat maps were used to identify a few promising areas close to center with low number of restaurants in general (and no BBQ restaurants in vicinity) and focus attention on those areas.

[2] List of venues supported by Foursquare are available at foursquare.com/categories/.

Finally, based on the initial analysis, a more focused investigation on the most promising area was done. Within the selected area clusters of locations were created that meet some basic requirements established in discussion with stakeholders:

- take into consideration locations with no more than two restaurants in radius of 250 meters
- want locations without BBQ restaurants in radius of 400 meters.

This was used to present map of all such locations but also create clusters (using k-means clustering) of those locations to identify general zones / neighborhoods / addresses which should be a starting point for final 'street level' exploration and search for optimal venue location by stakeholders.

3.1 Exploratory Data Analysis

In the candidate neighborhood around the Texas State Capitol, there are 425 restaurants with an average number of 2.63 restaurants in each candidate neighborhood (area with a radius of 300 meters). This includes 34 Barbecue (BBQ) restaurants which accounts for 8% of the restaurants in the area. The average distance to the nearest Barbecue (BBQ) restaurant from every area candidate center across the entire area is 1205.265 meters. This indicates a relative low density of Barbecue (BBQ) restaurants in the Austin Texas city center.

Two heat maps were created to show the density of restaurants in general and Barbecue (BBQ) restaurants specifically around the Texas State Capitol. The first heat map shows the density of restaurants surrounding the Austin Texas city center (Figure 3). This shows that there are a few pockets of low restaurant density closest to city center can be found east, north-east and north-west from the Texas State Capitol.

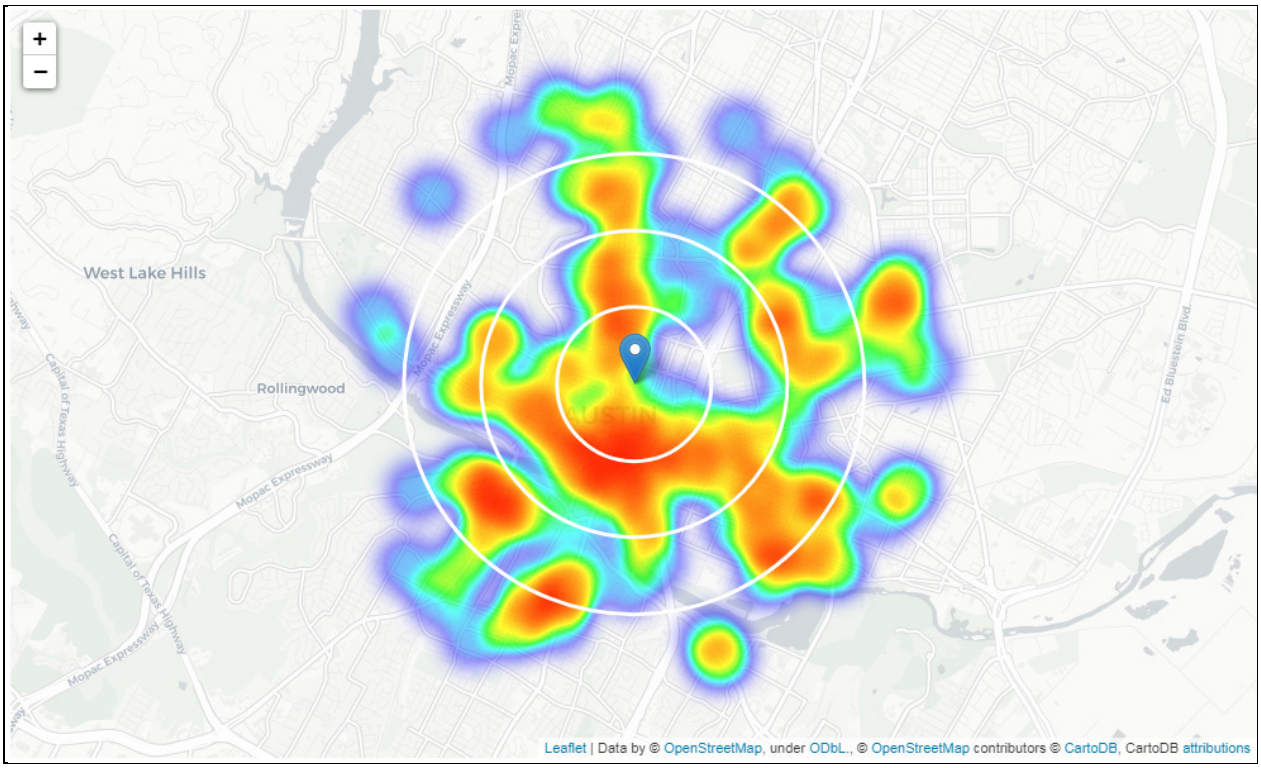

Figure 3: Heat map of restaurant density around the Texas State Capitol (circles for 1km, 2 km and 3km radius from city center)

The second heat map shows the density of Barbecue (BBQ) restaurants surrounding the Austin Texas city center (Figure 4). This map is not so 'hot' (BBQ restaurants represent a subset of ~8% of all restaurants in our target area), but it also indicates higher density of existing Barbecue restaurants directly east and south-east from the Texas State Capitol, with closest pockets of low BBQ restaurant density positioned in the west, north-west, and north-east from city center.

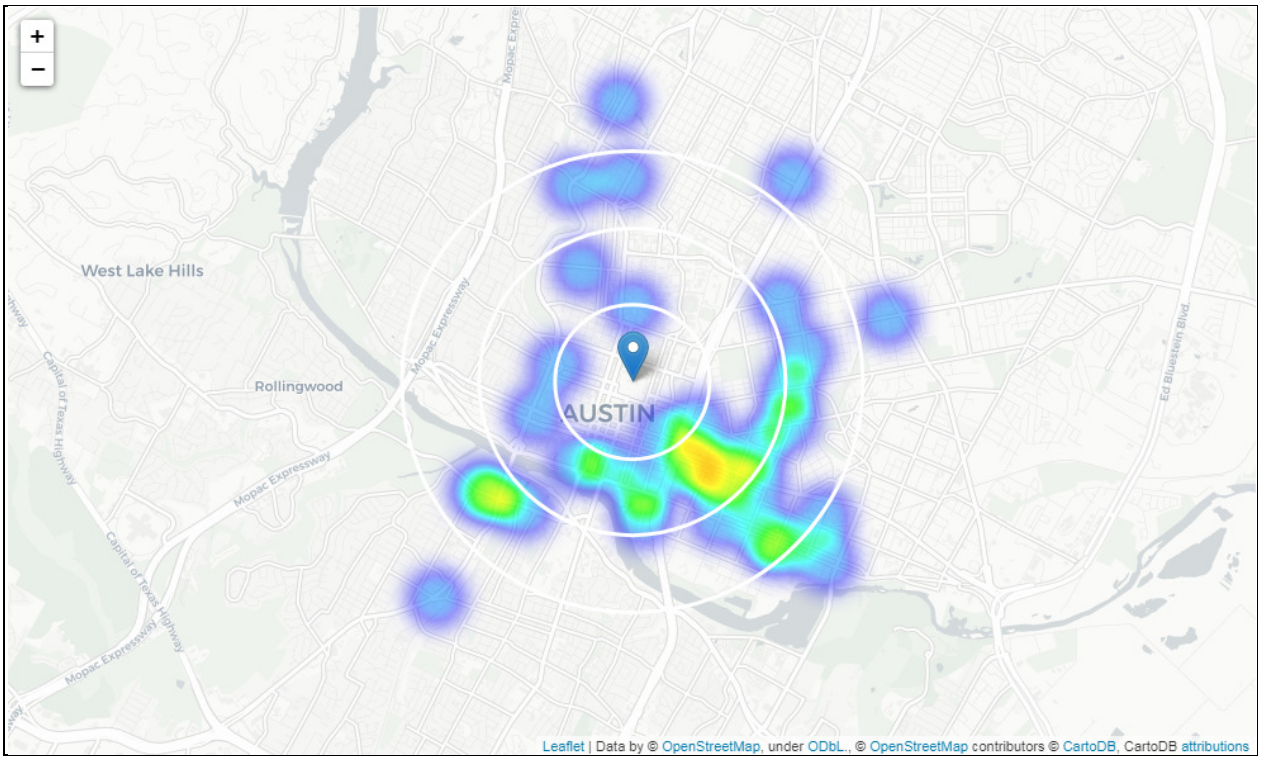

Figure 4: Heat map of Barbecue (BBQ) restaurant density around the Texas State Capitol (circles for 1km, 2 km and 3km radius from city center)

Based on this information it was decided to focus further analysis on areas west, north-west, and north-east from Austin, Texas center. This places the new location candidates mostly near The University of Texas at Austin. Another potentially interesting area is Clarksville with large low restaurant density west from city center. However this borough is less interesting to stakeholders as it's mostly residential and less popular with tourists.

3.2 Neighborhood Analysis

3.2.1 University of Texas at Austin Area

"The University of Texas is in the heart of Austin, both geographically and spiritually. Just north of the Capitol, the main campus hums with activity, from athletics to the arts to cutting-edge research. First opened in 1883 on 40 acres of land set aside by the state, the University has grown rapidly since: The 50,000-plus students and some 24,000 faculty and staff live by the motto "What Starts Here Changes the World," and Longhorns have proven that by winning Oscars (Matthew McConaughey), earning Olympic medals (Mary Lou Retton) and guiding us through the Cosmos (Neil deGrasse Tyson). The campus is a lovely place to explore, especially around the Spanish Renaissance-style older buildings. Just be prepared to hoof it: with parking limited and a little tricky at times, you won't want to move your car once you claim a space for the day. Wear your comfortable shoes and start your UT exploration with these five landmarks." (travelandleisure.com)

"Sheltered on the University of Texas at Austin campus, the Blanton Museum of Art is a must-see for any art enthusiast. Considered as one of the largest university art museums in the country and home to more

than 18,000 works of art – ranging from Renaissance and baroque pieces by renowned artists such as Rubens and Poussin to a sizeable collection of contemporary Latin American art." (travel.usnews.com)

"This museum was designed to tell "the Story of Texas", and does so across 3 floors of interactive exhibits. Each floor has a different theme, coving the Texan land and identity. The star attraction is the 400-seat IMAX theatre, which shows new and classic movies. Be sure to check out the original NASA Mission Control consoles and oil field drill bits on the 3rd floor. Head to the Story of Texas Café for local comfort food and snacks." (hotels.com)

"In a town like Austin, you would expect the largest university's Music Department to be something special. UT's Butler School of Music does not disappoint. Their events calendar is chock-full of amazing concerts to check out—from student groups to world-class touring ensembles—and their Midday Concert Series make for the perfect musical interlude on a weekday." (austinot.com)

"Texas football DKR stadium - One of the best football stadiums and football programs in the country. Experience tailgating, entertainment on Bevo Blvd and live music all on game day. Then go to the game. A truly great experience." (tripadvisor.com)

Popular with tourists, locals and students always out and about ready to eat, relatively close to city center and well connected, this area justified further analysis.

3.2.2 Narrowing Area of Interest

A new, 2.5Km region of interest which includes the low-restaurant-count parts of The University of Texas closest to the Texas State Capitol was defined. A more dense grid of 2261 location candidates 100m apart was created in this new region of interest.

Then using the restaurant data, the number of restaurants within 250 meters of each other and the distances to the closest Barbecue (BBQ) restaurant was calculated. The resulting table was then filtered to locations that meet the stakeholders two criteria:

- locations with no more than two restaurants in a radius of 250 meters
- locations with no Barbecue (BBQ) restaurants in a radius of 400 meters.

This resulted in 1890 locations meeting both criteria that have locations fairly close to the Texas State Capitol (mostly in the University of Austin area and just east of IH-35). Any of those locations is a potential candidate for a new Barbecue (BBQ) restaurant, at least based on nearby competition (Figure 5).

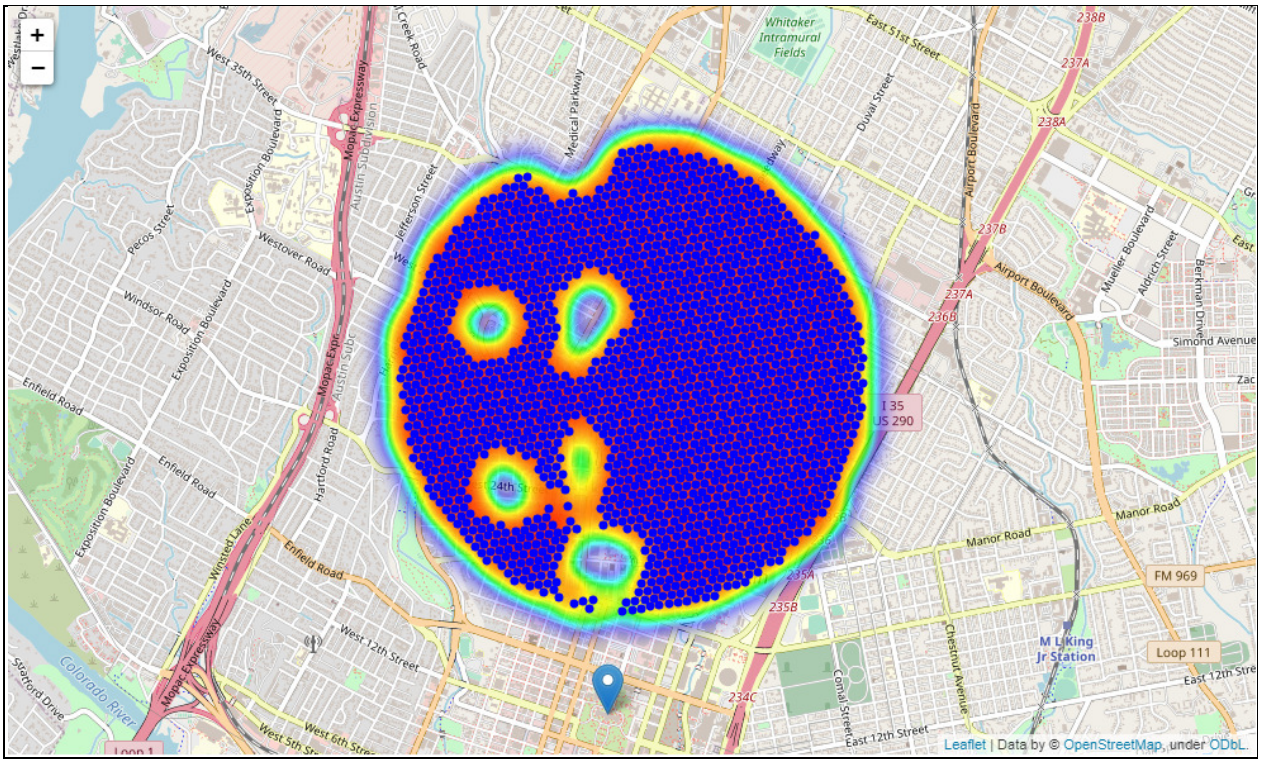

Figure 5: Heat map of potential locations in new University of Texas area (marker still shows the Texas State Capitol location)

3.2.3 Clustering Potential Locations

The potential locations were clustered using the K-means algorithm to create 15 clusters containing good locations. The clusters represent groupings of most of the candidate locations and cluster centers are placed nicely in the middle of the zones 'rich' with location candidates (Figure 6).

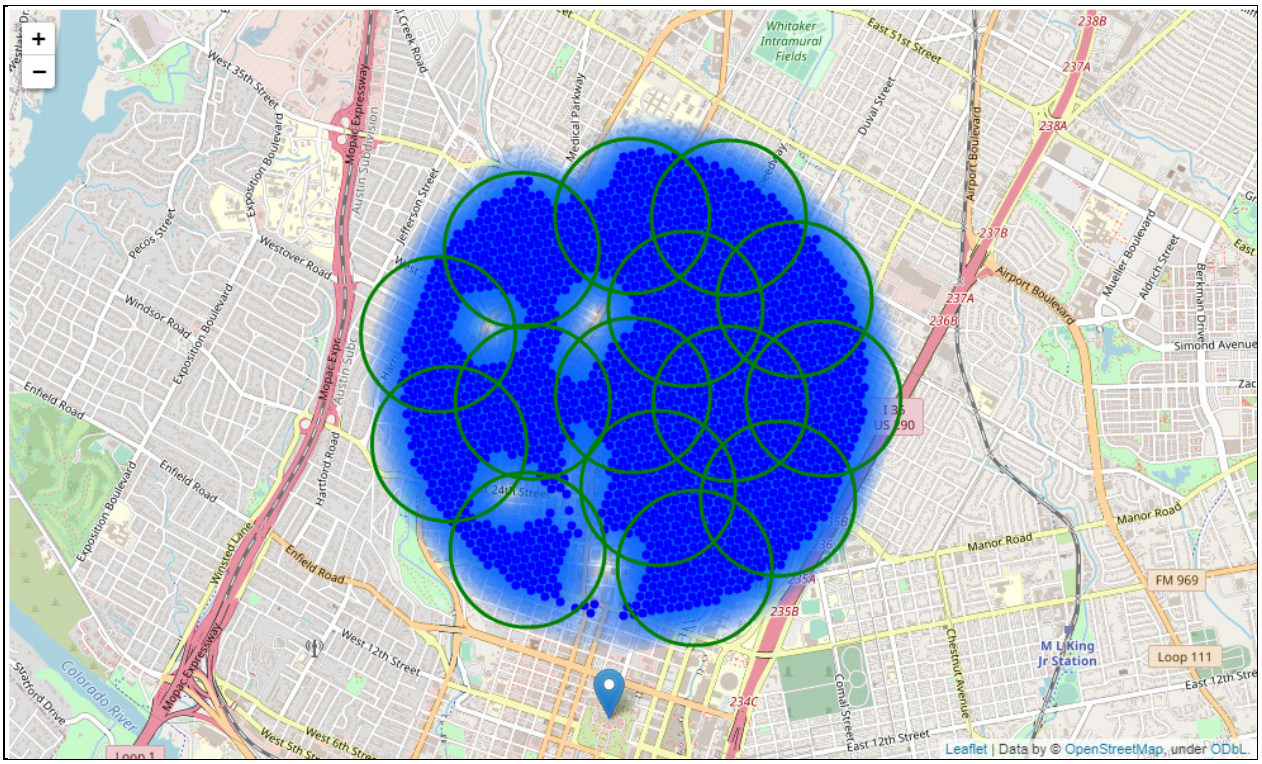

Figure 6: Map of Candidate Location Clusters

A list of 15 addresses was created representing centers of zones containing locations with low number of restaurants and no Barbecue (BBQ) restaurants nearby, all zones being fairly close to city center (all less than 4km from the Texas State Capitol, and about half of those less than 2km from the Texas State Capitol). Although zones are shown on map with a radius of ~500 meters (green circles), their shape is actually very irregular and their centers/addresses should be considered only as a starting point for exploring area neighborhoods in search for potential restaurant locations (Table 1 and Figure 7).

Table 1: Addresses of Center of Areas Recommended for Further Analysis

#	Street Address	Distance from Texas State Capitol
1	2904 University Avenue	> 3.5km
2	2701 Oakhurst Avenue	> 4.5km
3	4009 Avenue D	> 5.5km
4	Liberty Street	> 3.6km
5	704 West 21st Street	> 2.0km
6	1 East 21st Street	> 1.9km
7	803 West 28th Street	> 3.5km
8	Central Park	> 5.4km
9	Peck Avenue	> 4.9km
10	Speedway	> 2.5km
11	826 Harris Avenue	> 4.2km
12	West 33rd Street	> 5.1km
13	3406 Speedway	> 4.5km
14	East Dean Keeton Street	> 3.0km
15	North Lamar Boulevard	> 3.4km

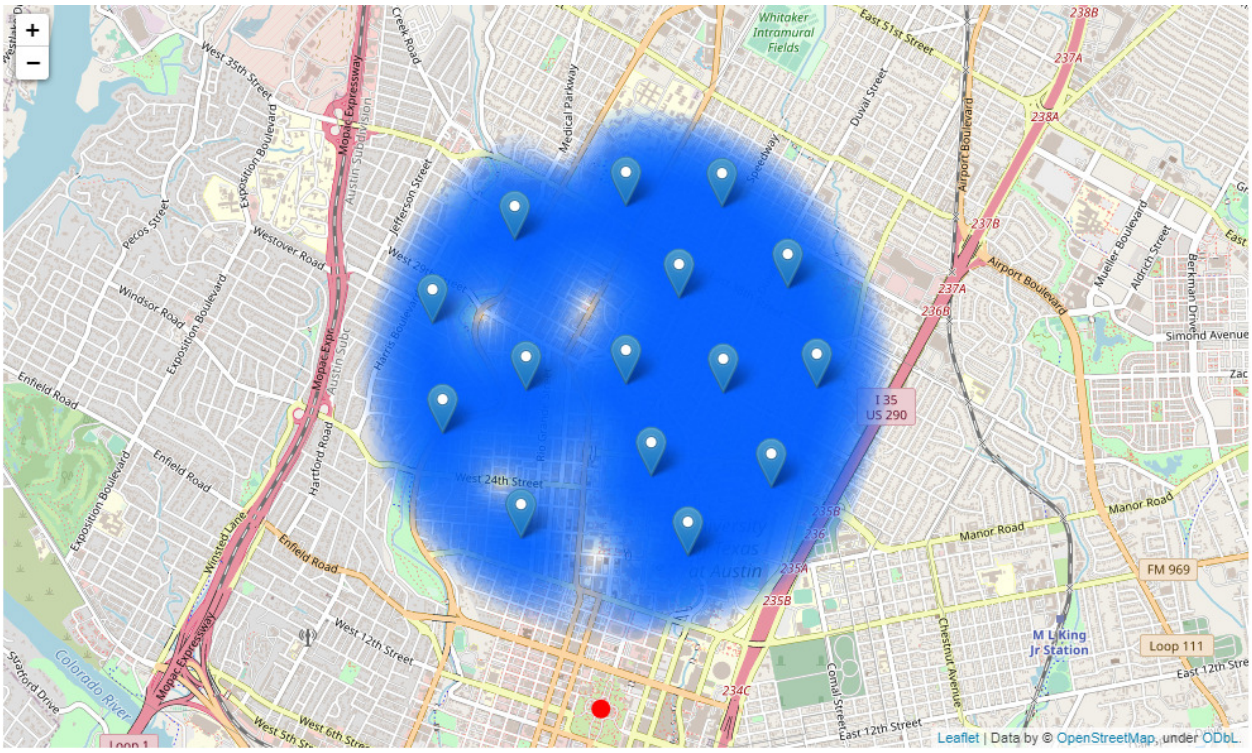

Figure 7: Map of Center of Areas Recommended for Further Analysis

Most of the zones are located in the University of Texas at Austin area, which has been identified as interesting due to being popular with tourists, fairly close to city center and well connected by public transport.

4 Results

The analysis shows that although there is a great number of restaurants in Austin (~425 in our initial area of interest which was 12x12km around the Texas State Capitol), there are pockets of low restaurant density fairly close to city center. Highest concentration of restaurants was detected south and east from the Texas State Capitol, so we focused our attention to areas west, north-west, and north-east , corresponding to the University of Texas at Austin area. Another borough was identified as potentially interesting (Clarksville, west from the Texas State Capitol), but attention was focused on the University of Texas at Austin which offer a combination of popularity among tourists, closeness to city center, strong socio-economic dynamics and a number of pockets of low restaurant density.

After directing our attention to this more narrow area of interest (covering approx. 1km north from the Texas State Capitol) we first created a dense grid of location candidates (spaced 100m apart). Those locations were then filtered so that those with more than two restaurants in radius of 250m and those with an Barbecue (BBQ) restaurant closer than 400m were removed.

Those location candidates were then clustered to create zones of interest which contain greatest number of location candidates. Addresses of centers of those zones were also generated using reverse geocoding to be used as markers/starting points for more detailed local analysis based on other factors. Result of all this is 15 zones containing largest number of potential new restaurant locations based on

number of and distance to existing venues - both restaurants in general and Barbecue (BBQ) restaurants particularly.

5 Discussions

The 15 zones identified will still require further investigation before a final location can be selected. While these do meet containing largest number of potential new restaurant locations based on number of and distance to existing venues, there are still other factors to consider before a final decision is made regarding the optimal location for a new restaurant. The purpose of this analysis was to only provide info on areas close to Austin, Texas center but not crowded with existing restaurants (particularly BBQ). It is entirely possible that there is a very good reason for small number of restaurants in any of those areas, reasons which would make them unsuitable for a new restaurant regardless of lack of competition in the area. Recommended zones should therefore be considered only as a starting point for more detailed analysis which could eventually result in location which has not only no nearby competition but also other factors taken into account and all other relevant conditions met.

6 Conclusion

Purpose of this project was to identify Austin Texas areas close to center with low number of restaurants (particularly BBQ restaurants) in order to aid stakeholders in narrowing down the search for optimal location for a new Barbecue (BBQ) restaurant. By calculating restaurant density distribution from Foursquare data we have first identified general boroughs that justify further analysis (University of Texas at Austin area), and then generated extensive collection of locations which satisfy some basic requirements regarding existing nearby restaurants. Clustering of those locations was then performed in order to create major zones of interest (containing greatest number of potential locations) and addresses of those zone centers were created to be used as starting points for final exploration by stakeholders.

Final decision on optimal restaurant location will be made by stakeholders based on specific characteristics of neighborhoods and locations in every recommended zone, taking into consideration additional factors like attractiveness of each location (proximity to park or water), levels of noise / proximity to major roads, real estate availability, prices, social and economic dynamics of every neighborhood etc.