Finding Optimal Locations for Food Truck Operators in San Francisco during Covid-19 Pandemic

Shang Horng Patrick Guo

January 24, 2021

1. Introduction

1.1 Background

The Covid-19 pandemic continues to cause widespread economic disruption leading to the permanent closure of thousands of businesses. Now an increasing number of people have difficulty procuring food supplies as many eateries are shutting down. Restaurants are trying to remain profitable despite losing a significant amount of business due to stay-in-shelter, no indoor seating, and social distancing amid health and safety concerns. However, some alternative eateries are continuing to operate and doing better than they imagined: food trucks. These services provide meals from motorized vehicles or carts.

Food trucks also experience lower sales due to the absence of office workers and large decline of street traffic. However unlike restaurants that are fixed facilities, food trucks can quickly change location, menu and market. Operators have adapted by branching out into residential areas to capitalize on the large portion of people staying at home or nearby essential businesses such as hospitals.

1.2 Problem

Food truck sales fluctuate wildly depending on a number of factors, most of which depend on location. This report uses machine learning tools to assist food trucks operators looking for the best locations in San Francisco. Due to the absence of office workers, we will try to detect locations near residential areas. We are also interested in locations near the workspaces of essential workers. The report will use data science analysis to generate promising San Francisco neighborhoods based on these criteria. Advantages of each venue will be expressed so that the best location can be chosen by stakeholders.

2. Data acquisition and cleaning

2.1 Data Sources

In San Francisco, food trucks must satisfy DPW Order 182,101 requirements to be a legal street-food vendor. Hence, they can only operate in the approved zones shown in red on Fig. 1.

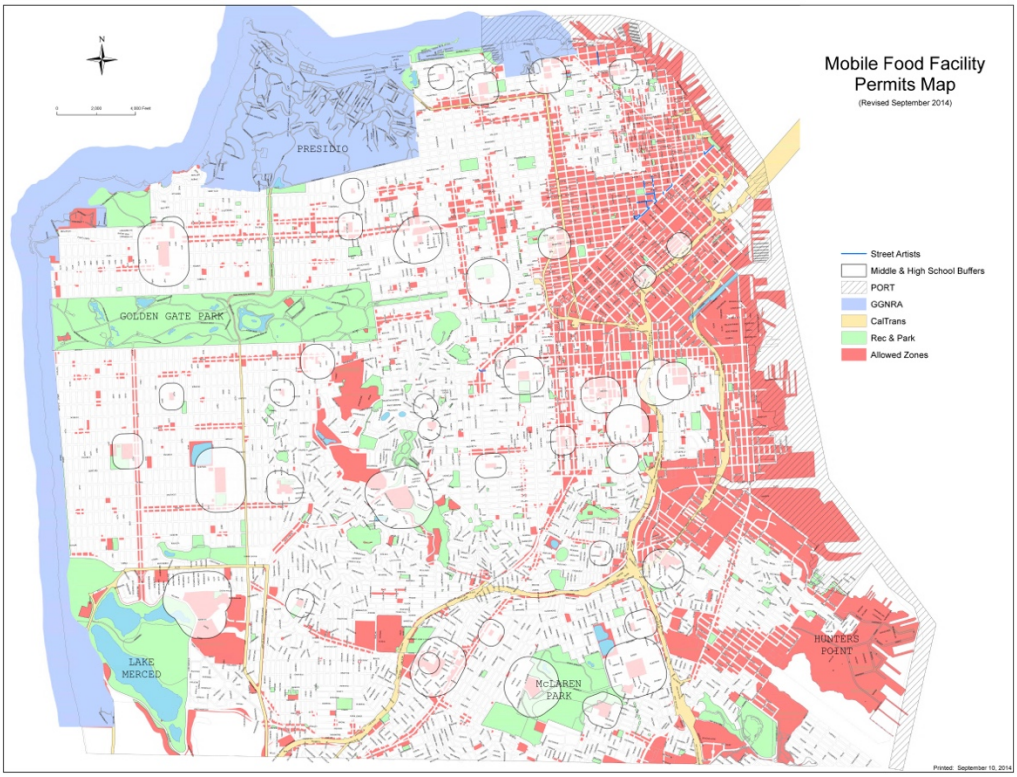

Fig. 1 Mobile Food Facility Permits Map of San Francisco California.

The report will obtain location candidates in the allowed zones from the latest Mobile Food Facility Permits data provided by San Francisco Department of Public Works on DataSF. This will be joined with location data from the FourSquare API to get information about the venues in each location. We also need a list of essential businesses as defined by sf.gov. Finally, we will use the Geocoder API to get latitude and longitude coordinates of our locations.

2.2 Feature Selection and Data Cleaning

There were 653 rows and 24 features in the Mobile Food Facility Permits dataset. At first glance, there are several missing values and mislabeled data, where the latitude or longitude cell has the value 0. Additionally, after examining the meaning of each feature, it was clear that there were some redundancies. Our analysis only requires Mobile Food Facility Permits data about the type of facility permitted (whether it was a food truck or location), the address, the location, and the status of the permit. We filter the data only contain issued zone permits for food trucks.

For the venue categories obtained from the foursquare API, we notice that there are 119 categories, but they include businesses that are shut down during the Covid-19 pandemic, hence we filtered the categories to only contain essential businesses as defined by sf.gov. We also included residential buildings in the categories we are interested in. We notice that there are only six venues categories that are relevant.

Finally, data downloaded or scraped from multiple sources were combined into one table.

3 Methodology

3.1 Obtaining locations candidates
We parse through the location column in the Mobile Food Facilities Permits dataset to obtain the latitudes and longitudes for our location candidates.

3.2 Type and location of the venues nearby our locations
We identified the type and location of the neighborhoods according to Foursquare categorization using the latitudes and longitudes from the previous step. Due to request limitations for the number of places per neighborhood, the limit parameter is set to 100 and the radius parameter is set to 500.

3.3 Essential Businesses and Residential Buildings
We cross reference the list of essential businesses as defined by sf.gov to filter the list of venue categories produced by the Foursquare API.

3.4 K-means clustering
We focus on the most promising areas and create clusters (using k-means clustering) of locations that meet the requirements established in the discussions with the stakeholders.

3.5 Folium Map
We present a map of all clusters and approximate the addresses using Google Maps API reverse geocoding which allow stakeholders to search for optimal venue locations.

4 Analysis

4.1 Top venues of each location
We use one-hot encoding to convert the Foursquare categorical data into numerical data. Next we group each location by their venue categories and display their most common venue as seen in Fig 2.

	Neighborhood	1st Most Common Venue
0	400 CALIFORNIA ST	Convenience Store
1	601 03RD ST	Residential Building (Apartment / Condo)
2	727 SANSOME ST	Optical Shop

Fig 2. 1st most common venue for each neighborhood.

Address 0 and 2 are near essential businesses open during Covid-19 pandemic. Whereas address 1 is near residential buildings. At a glance, address 0 seems to be a better candidate compared to address 2 as there is likely to be more street traffic near a convenience store compared to an optical shop. However, the effect the type of essential business on food truck operation is out of scope for this repoort would require further analysis.

Fig 3 shows the map of all our clusters and approximate the addresses of the clusters using Google Maps API reverse geocoding which allow stakeholders to search for optimal venue locations as show in Fig 4.

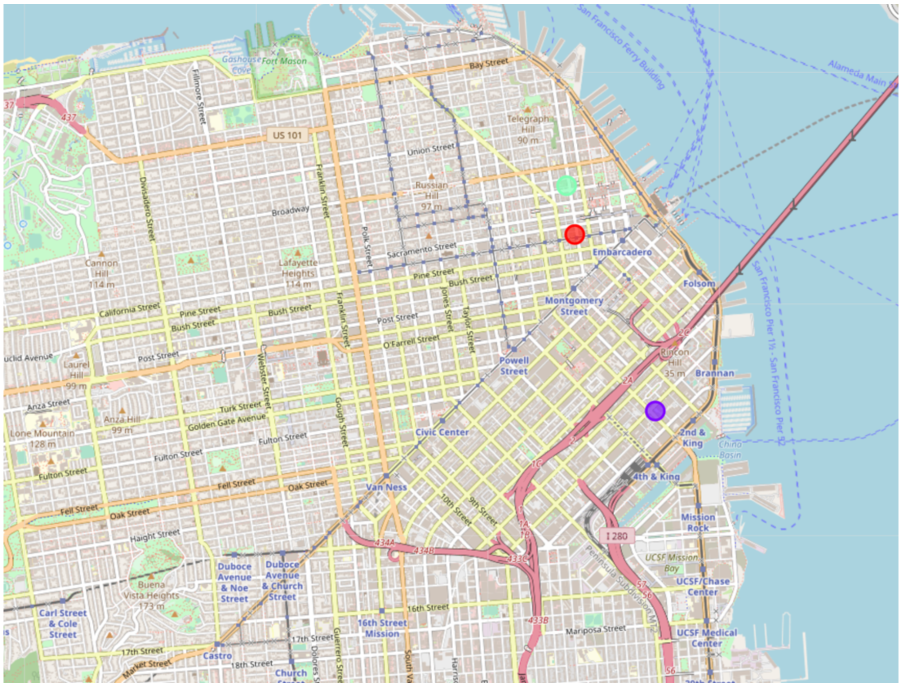

Fig 3. Folium map of clusters of Food truck locations in San Francisco

```
============================================================
Addresses of areas recommended for further analysis
============================================================

601;605, 3rd Street, South Beach, San Francisco, San Francisco City and County, California, 94017, United States
400;410, California Street, Financial District, San Francisco, San Francisco City and County, California, 90104, United States
705;727;729, Sansome Street, Northeast Waterfront Historic District, San Francisco, San Francisco City and County, California, 94133, United States
```

Fig 4. List of addresses obtained from Google Maps API reverse geocoding

The first and second address are closer to each other compared to the third address. It is more probable that a good location for food truck operation is near those two addresses.

5 Results and Discussion

Our analysis shows that there is a large area of approved zones in Mobile Facility Permits map. The highest concertation of approved zones is on the East side of San Francisco. After directing our attention to this narrower area of interest, we filtered our location candidates to only include approved zones for food trucks that are currently issued. These location candidates were then clustered to create zones of interest which contain the greatest number of location candidates.

The results show 3 zones for potential food truck locations. The addresses of those zones are generated using reverse geocoding. However, this does not imply that those addresses are actually optimal locations for a food truck. The recommended addresses should be considered

only as a starting point for more detailed analysis which could eventually results in an optimal location when other factors are taken into account and all other relevant conditions are met.

6 Conclusion

The purpose of this project was to identify San Francisco areas in order to aid stakeholders to narrow down the search for the optimal location for a food truck operation during the Covid-19 pandemic. We generate a collection of locations which satisfy some basic requirements regarding zones that are approved for mobile food facilities. We then performed clustering to create major zones of interest and the addresses of those zones were labelled to be used as starting point for final exploration by stakeholders.

The final decision for optimal food truck operation will be made by stakeholders based on the specific characteristics of the neighborhoods and locations in every recommended zone while taking into consideration of additional factors such as street traffic, enough space for social distancing etc.

Work Cited

City and County of San Francisco. “Check if a business can be opened.” Sf.gov. Jan 21, 2021. https://sf.gov/check-if-business-essential Accessed Jan 21 2021.

DataSF. *Mobile Food Facility Permit.* San Francisco: San Francisco Department of Public Works. Jan 23 2021. https://data.sfgov.org/Economy-and-Community/Mobile-Food-Facility-Permit/rqzj-sfat Accessed Jan 23 2021.

DPW Order No: 182101. San Francisco Department of Public Works. Jan 22 2014. https://www.sfpublicworks.org/sites/default/files/3858-DPW%20Order_182101-MFF.pdf Accessed Jan 21 2021.