Urban Spatial Analytics

Freegan Trash Tour - A Spatial Approach to Freeganism

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Freeganism is an urban subculture focused on satisfying material needs through unconventional means such as foraging, swapping goods and skills, and squatting to reduce waste and the environmental impacts of consumption.[1] The large, well-established Freegan community in New York City holds regular meetings, largely in Manhattan, that culminate in nighttime excursions called ‘‘Trash Tours’ to salvage both food and nonfood items that supermarkets and other merchants leave curbside for solid waste haulers to collect at the end of the business day.[2]

Although many conflate Freeganism and dumpster diving, New York City Freegans have to do little in the way of rummaging through receptacles. Because New York City merchants tend to leave bagged waste on the sidewalk and not in dumpsters, gleaning requires little physical effort. The real effort is arguably psychological: overcoming the social taboos surrounding rifling through trash and pulling from it items to consume.[3] Most Freegans do strive be tidy and retie and stack opened bags so as to not upset merchants who face fines for messy waste disposal.

Freegans and industry executives affirm that much of the waste upscale chain supermarkets generate stems from intentional overstocking of goods to enhance shoppers’ sense of abundance.[4] Once items near or pass their expiration dates, merchants are obligated to dispose of them even though the items may still be fit for consumption. Thus, much of the waste available for Freegan gleaning is of high quality and expensive when bought from the shelf. The authors learned through conversations with the leader of the New York City Freegan group that many Freegan participants have a high level of experience gleaning sites in Manhattan and know how and where to find the ‘good stuff’. We can therefore surmise with confidence that Trash Tour routes are chosen at least in part to be near the sites likeliest to yield a lot of high-quality waste.

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[1] Scarlett Lindeman. “Trash Eaters.” *Gastronomica*, vol. 12, no. 1, 2012, pp. 75–82. *JSTOR*, JSTOR, 23 October 2018 <www.jstor.org/stable/10.1525/gfc.2012.12.1.75>

[2] “Freegan Events in New York.” *Freegan.info: Strategies for Sustainable Living beyond Capitalism*, <freegan.info/what-is-a-freegan/freegan-events-in-new-york/>

[3] See Lindeman for a discussion of the social distinctions surrounding trash and food.

[4] Alvarez, Jose B., and Ryan C. Johnson. ”Doug Rauch: Solving the American Food Paradox.” *Harvard Business Review*, Nov. 2011.

This project explores the spatial relationship between Freegan Trash Tour sites and the Manhattan neighborhoods in which they are conducted to test this assumption. It has the following aims: to determine how Trash Tour attendance figures are related based on the locations where the tours take place, and to determine whether Trash Tours are operating in places where the largest quantity of items are discarded represented as retail merchant density. By analyzing these variables, we seek to understand whether location plays any role in the attractiveness of a Trash Tour site as measured by attendance levels per site, and to find an optimized route to reap the largest potential haul for Freegans.

Data

Data used in this project are both natively spatial in form and natively nonspatial transformed into spatial form. Natively spatial data was used to segment Manhattan into neighborhood polygons as represented in Public Use Microdata Areas (PUMAs)[5], census tracts[6], and census blocks.[7] All three shapefiles required filtering to isolate Manhattan from the other New York City boroughs. Natively spatial data was also used in the form of a GPS exchange format file author Sarah Sachs used to log the route of one Freegan Trash Tour in the Greenwich Village neighborhood.

Nonspatial data including Freegan meetup venues and their attendance was pulled from the meetup.com API.[8] We transformed and wrote venue coordinates into a points shapefile using the GeoPandas Python package.[9] We pulled nonspatial data on retail merchant identification[10] from the State of New York open data catalogue by calling the Socrata API with the sodapy Python package.[11] Merchant location coordinates were also spatially transformed and written into a points shapefile using GeoPandas. Both meetup location and Manhattan retail merchant location points were spatially joined to the PUMA, census block, and census tract polygons with GeoPandas.

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[5] *Public Use Microdata Areas (PUMA)*, New York City Department of City Planning, 2015. Shapefile. 15 November 2018. <https://data.cityofnewyork.us/Housing-Development/Public-Use-Microdata-Areas-PUMA-/cwiz-gcty/data>

[6] *2010 Census Tracts*, New York City Department of City Planning, 2015. Shapefile. 15 November 2018. <https://data.cityofnewyork.us/City-Government/2010-Census-Tracts/fxpq-c8ku>

[7] *2010 Census Blocks*, New York City Department of City Planning, 2015. Shapefile. 15 November 2018. <https://data.cityofnewyork.us/City-Government/2010-Census-Blocks/v2h8-6mxf/data>

[8] *Extend your community,* Meetup.com. 18 November 2018. <https://www.meetup.com/meetup_api/>

[9] GeoPandas developers, GeoPandas 0.4.0.

[10] *Retail Food Stores*, New York State Department of Agriculture and Markets, 2013. Dataset. 2 November 2018. <https://data.ny.gov/Economic-Development/Retail-Food-Stores/9a8c-vfzj>

[11] sodapy developers, Python bindings for the Socrata Open Data API 1.2.0.

Methods

Once the Freegan meetup data and merchant location data were spatially transformed, we engaged in exploratory data analysis to determine whether any clear patterns, clusters, or relationships emerged between merchant sites and Trash Tour sites. With the intention of concentrating on quality of discarded items, we initially focused on the locations of four well-known upscale Manhattan supermarket chains: Whole Foods, Trader Joe's, D'Agostino's, and Gristedes.

Plotting the locations of these four chains' curbside disposal sites against the Freegan meetup locations revealed clusters of the merchants and meetup sites near in space. There are 18 Freegan meetup locations in Manhattan, all of which are south of Central Park North. The four chains combined operate 42 branches throughout the borough, all of which (save one Whole Foods location on 125th) are south of Central Park North. Thus, some visual clustering is to be expected.

After learning from the Freegan meetup group leader that many Duane Reade locations and standalone shops and restaurants often yield terrific finds, we shifted focus from only upscale markets' high-quality waste to analyzing quality and the available volume of waste as represented by overall merchant density in a location.

We also explored the distribution of Trash Tour attendance figures for the 17 Manhattan meetup locations and learned Upper West Side locations have high attendance figures despite low merchant density, while Lower East Side locations see lower attendance figures despite high merchant density. This incongruity led us to further explore the spatial relationship of Trash Tour attendance figures.

Global Moran's I

We also sought to determine how Freegan meetup attendance figures are related spatially. We anticipated positive spatial autocorrelation based on our visual inspection of map patterns. Total attendance was calculated by aggregating RSVP counts as provided in the meetup.com data. Counts were then added as an attribute to the meetup points geodataframe. Attendance values per venue range from a minimum of 18 (a spot along the High Line) to 324 (the Wall Street Atrium) for the past two years.

We performed a global Moran's I test of autocorrelation using the R package spdep[12] run on meetup site attendance figures per PUMA, census tract, and census block. All results show positive spatial formation, which, again, the authors expected owing to the Freegan group's repeated use of a number of meetup sites exclusively south of Central Park North. Autocorrelation strength was weak to nearly nonexistent, however, depending on the size of the surrounding space.

Using a row-standardized, rook's case spatial weights matrix, attendance numbers per PUMA yielded a Moran's I test statistic of 0.261, indicating mildly positive spatial autocorrelation, with a small positive Z-score of 1.661 indicating a little clustering. For PUMA spaces, the test p-value was 0.048, indicating the spatial distribution of high attendance and low attendance sites is more clustered than would be expected in a random underlying spatial process.

Figure 1: Manhattan PUMAs plotted with rook's case neighbors

Using a row-standardized, rook's case spatial weights matrix with no-neighbor observations removed, the attendance numbers aggregated by census tract yielded a test statistic of 0.024, Z-score of 0.8 and high p-value of 0.21. Using the same type of weights matrix, aggregation by census block yielded a test statistic of 1.27e-02, Z-score of 1.39, and p-value of 0.08. Given the test statistics of near zero of the census tract and block spaces, we concluded there is neither clustering nor dispersion of meetup sites based on their attendance.

[12] Bivand, Roger S. and Wong, David W. S. (2018) Comparing implementations of global and local indicators of spatial association TEST, 27(3), 716-748. <https://doi.org/10.1007/s11749-01

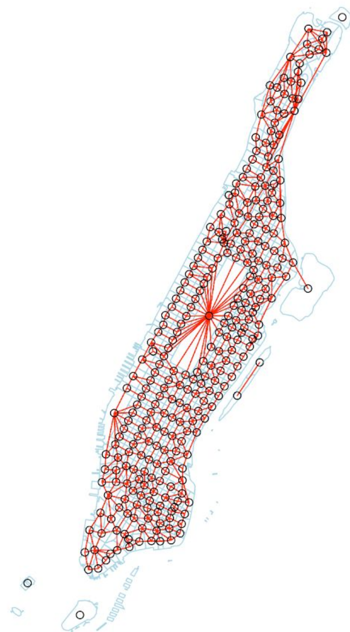

Figure 2: Manhattan census tracts plotted with rook's case neighbors

The different outcomes of our three Global Moran's I tests illustrate the importance of the spatial extent used in the autocorrelation analysis. The weak autocorrelation strength persisted across all three spaces, however the Moran's I test statistic across PUMAs was both higher than the other two geographic units and the only statistically significant result. Additional Global Moran's I tests using inverse distance or nearest neighbor spatial weights may provide further insight.

Semivariogram/ Kriging Model

We next explored the idea that a combination of census tract attendance counts close in space would display similarity that could shed light on why Trash Tours are held where they are. To do so, we constructed a semivariogram to analyze the spatial variance of attendance count per census tract. We expected spatially near points to exhibit less variability. Using a bespoke Python function,[13] we calculated covariance with a semivariogram and plotted the distribution of lagged distances to determine the distance at which the semivariance levels off.

Taking this one step further, we engaged in spatial interpolation of two Freegan attendance values for points that lie at the start and finish of the authors' Trash Tour route. We built a simple model using

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[13] Johnson, Connor. *Simple Kriging in Python*. 21 November 2018. <http://connor-johnson.com/2014/03/20/simple-kriging-in-python/>

the semivariogram covariance input and relying on the six nearest Freegan meetup points. Our krigin estimate for these points were 23.32 for the route finish point and 16.2 for the route beginning point, both with small standard deviations. The larger attendance count corresponded to a higher store count of the two points' census tracts.

In constructing a Kriging model manually rather than established Python packages, we hoped to gain a stronger conceptual understanding of how the model works. We did encounter strange and obviously erroneous values for some of the model runs, but were able to suss out the needed procedures at every step.

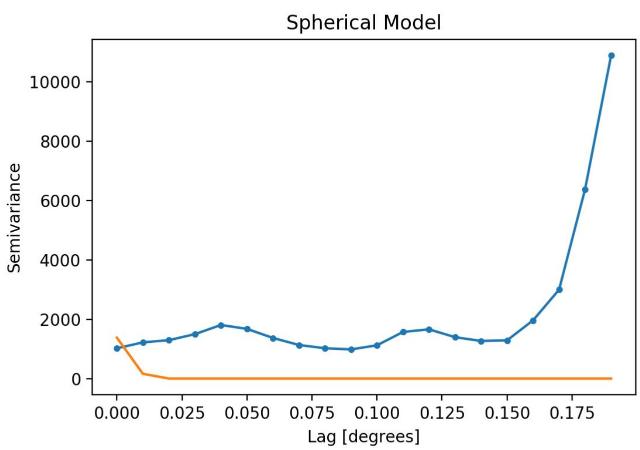

Figure 3: spherical model of semivariance of Freegan attendance sites, with degrees as lag units

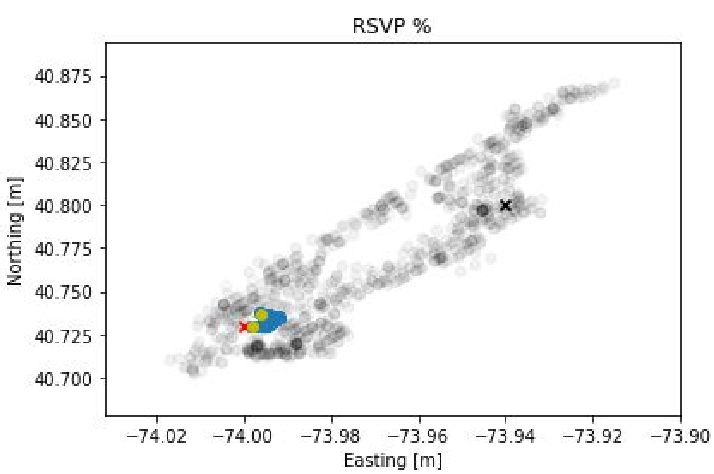

Figure 4: Krigin estimation points for Freegan attendance sites on authors' route

Gravity Model

We lastly sought to determine whether store density could be used to determine an attractive Trash Tour site. Four of the ten Manhattan PUMAs have never hosted a Trash Tour site, and, as noted above, they are all north of Central Park. Using the Huff Gravity Model[14], we calculated the probabilistic attraction of a Trash Tour site at the Whole Foods Market on 125th Street. The model uses the overall store count of that Whole Foods PUMA as the attractiveness parameter under the assumption store density is a main factor attracting Freegans to a particular site. The model uses all other Manhattan PUMAs as origins.

To build the model, we first added the 125th street location as a point in the Trash Tour sites shapefile and then constructed a distance table with existing Trash Tour sites as the near features. Splitting this table by Trash Tour site yielded 19 separate tables, which were then joined to the PUMA polygons via an attribute join on the FID/IN_FID fields. To avoid unwanted zero probabilities, we added a small distance coefficient to the near distance values of zero that were created from existing-Trash-Tour-in-PUMA joins.

To calculate attractiveness of each location, we divided the store count in the location's PUMA by the square of near distance values. To complete this step, we created a total attractiveness variable by summing the site attractiveness values save the prospective Trash Tour site, and created an all-site attractiveness variable by summing all site values. We next based before-site and after-site probabilities on the proportion of site attractiveness by total attractiveness and all-site attractiveness, respectively. Probability for the new site was calculated as the site attractiveness divided by all-site attractiveness.

Applying the model yielded surprising results. The store count of the proposed Trash Tour site PUMA proved to be a weak factor of attraction; the new-site PUMA probability was lower than the a priori probability. Moreover, the PUMA comprising the northernmost tip of Manhattan, situated farthest from existing Trash Tour sites, saw the highest before and after probabilities.

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[14] Huff, David L. "A Probabilistic Analysis of Shopping Center Trade Areas." *Land Economics*, vol. 39, no. 1, 1963, pp. 81–90. *JSTOR*, JSTOR, <www.jstor.org/stable/3144521>

Figure 3: Choropleth of probabilities of attendance for a proposed Trash Tour site at Whole Foods on 125th street.

Figure 4: Choropleth of probabilities of attendance for a proposed Trash Tour site at Whole Foods on 125th street.

This suggests store count is overall not a powerful factor in the Freegan meetup group's Trash Tour sites, and that an optimal site would not be chosen alone on this factor. Additional research into store type, perhaps revisiting the idea of upscale-chain counts in combination with overall store count, would bring needed additional insight to better understand why Trash Tours are conducted where they are.

Statement of Work

Both authors engaged in data collection and cleaning with Sarah logging the authors' Trash Tour route using the GPX Tracker mobile app. Ursula performed points to polygon spatial joins and wrote the resulting shapefiles. Sarah performed the global Moran's I test on store and meetup location and built the attendance count per store count semivariogram. Ursula performed the global Moran's tests on attendance and the gravity model.