Violet Lingenfelter

24 April 2019

Word count: 2790

Street Shit: An Analysis of Human Waste Reports in San Francisco

Introduction

In 2014, the city of San Francisco, through its Department of Public Works, launched an initiative to cut down on human feces complaints in the city. This program is a network of public restrooms that are maintained by the department of public works, and contain safe needle disposal sights, restroom facilities, and pet waste disposal sites. The program, the Pitstop Program, has been lauded as a success, but still, media coverage of the human waste in San Francisco has increased, indicating that general discontent with street cleanliness has increased as well. Human waste on the streets presents a health hazard, as well as general discomfort. At the very least, cleaning this waste is a drain on limited city resources, so programs like the Pitstop program are essential to intercept this waste before it ends up on the streets.

This analysis seeks to determine whether there are certain factors that predispose an area to having more 311 cases regarding human feces. By finding what predisposes a neighborhood to this problem, I hope to determine possible methods of intervention so that feces can be diverted away from the city streets and into a toilet. This analysis will focus on the most recent year of full data, 2018. I will look at data from the census, from other 311 incidents, human waste

incidents from prior years, and 911 calls to see if any of these factors predispose a neighborhood to high human waste case volumes.

This analysis will look at both when and where cases about human feces occur to see if the hours of operation and the locations of the Pitstops are effective. This paper will conclude with policy recommendations to improve the Pitstop program.

Background

San Francisco is known for its relatively large homeless population. More than 7,000 people self-reported experiencing homelessness in in 2017, which is slightly less than 1% of the city population. This means that 1 out of every 100 people in San Francisco experienced homelessness during the year. (U.S. Census Bureau, 2016). Of that population, 58% reported being unsheltered (Applied Survey Research, 2017). In the 2015-2016 fiscal year, the city spent more than $241 million on homeless services (Knight and Fagan, 2016).

The Pitstop Program is an initiative by the San Francisco Department of Public Works which aims to provide safe and clean toilet, safe needle drop off locations, and pet waste disposal in areas that are of outstanding need in the city. The program features park restrooms, portable toilets, and JCDecaux self cleaning public toilet facilities. JCDecaux facilities also double as advertising billboards. The facilities kept by the program are “maintained to a standard where parents and guardians would feel comfortable bringing their children” , and are not open at night. Collectively, the restrooms are open from 7 a.m. to 9 p.m. An explicitly stated result of the program is that “complaints about human waste in public spaces around the Pit Stop locations

have gone down" (Department of Public Works). This can be checked by analyzing the 311 reports of human waste in the city before and after the program was implemented.

The City of San Francisco makes all 311 reports public. These calls include calls regarding human waste that must be cleaned up. When the Department of Public Works cleans human waste, they power wash the sidewalk where the incident occured. This means that the odor and the appearance of the waste is eliminated, but the process vaporizes the feces and makes it airborne. I have heard anecdotal evidence from some of those experiencing homelessness in the city that the ingestion of airborne feces has caused many of the homeless population in the city to suffer from digestive illness, such as the shigellosis caused by the shigella bacteria. Shigellosis is contracted from contact with feces, and the main sign of infection is diarrhea (Mayo Clinic, 2019). It follows logically that cleaning feces in this manor is dangerous and can potentially lead to more feces, and therefore the best strategy for combating human waste in the streets is prevention.

The Pitstop program is an intervention program designed to mitigate human waste in the streets, therefore saving DPW man hours, and potentially preventing public health problems. Analyzing the effectiveness of the program will help to inform future policy action and potential extension of the program.

Methods

Data for where human feces is occurring and where encampments are was taken from 311 data published by the city of San Francisco. Demographic information was taken from the American Community Survey conducted by the U.S. Census Bureau. 911 call volume was

approximated by 911 call volume that was directed to SFFD (San Francisco Fire Department) and was obtained from the city of San Francisco. The locations of the restrooms in the Pitstop program were also taken from the San Francisco Open Data Portal.

All call data (both 311 and 911) was subsetted so that only calls that had locations attributed to them were included in the analysis. Approximately 10% of 311 calls did not have correct locational attributes or any locational attributes at all (where "correct" locational attributes are ones that fall within the boundaries of San Francisco). This is a large enough loss that it is worth noting.

I created a spatial weights matrix using queen contiguity and calculated spatial lag for human waste reports in 2018. I then tested for spatial autocorrelation with Moran's I, finding I=0.62437 with P=0.001. This indicated global spatial autocorrelation. To look for local autocorrelation, I calculated LISAs. I ran OLS spatial diagnostics to confirm this Moran's I value and ran both Lagrange multiplier test for spatial lag model as well as lagrange multiplier test for spatial error model, and both were significant so I chose to create a generalized method of moments model to explain human waste calls.

In my regression, I included demographic information as to the percentage of population that identifies as white, the total number of vacant units, the total number of 911 calls to the fire department, the total number of 311 calls, the total number of calls regarding encampments, and the population density, all from 2018, which is the last full year of data for both 311 calls and 911 calls, and all aggregated to the census block level. I also chose to include the number of calls in each block regarding human waste from 2013, which was the year before the Pitstop program was implemented and presumably the year of data that the Pitstop locations were based upon.

Results

Temporal Analysis

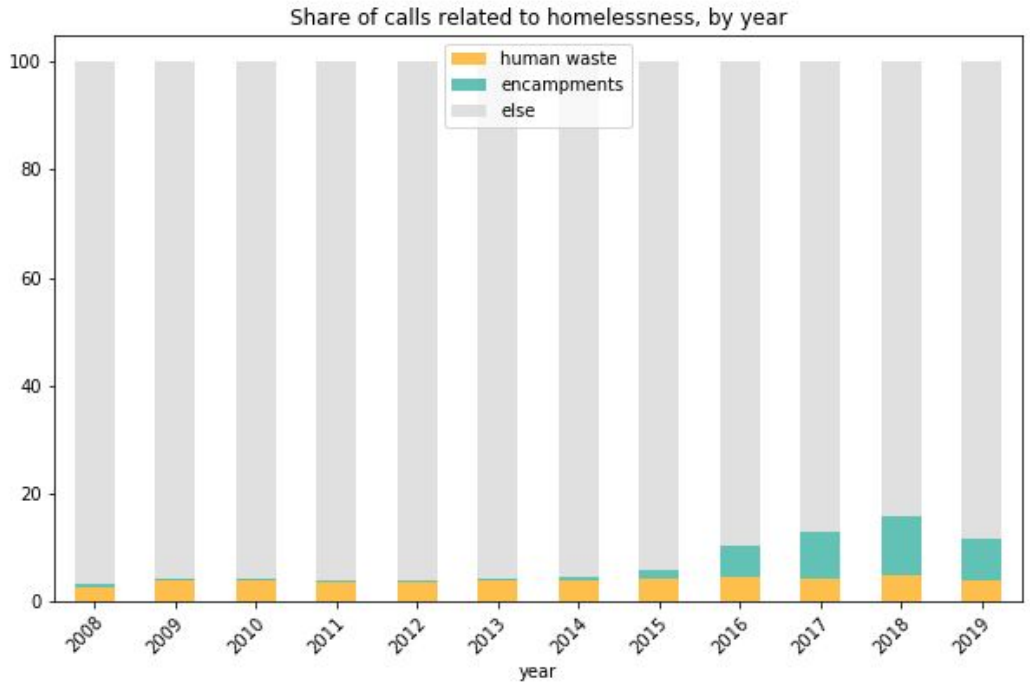
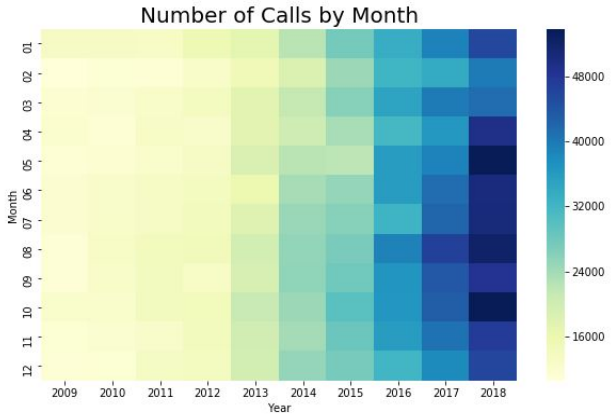


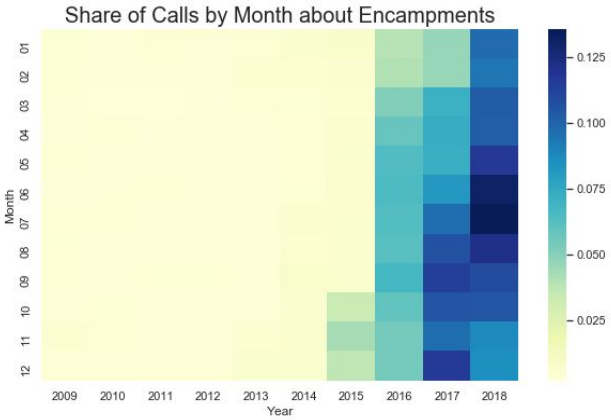
Figure 1: Relative shares of total 311 calls per year regarding homelessness concerns, broken down by calls regarding human waste and calls regarding encampments.

The number of 311 reports concerning human feces has grown since 2009, but it has grown at nearly the same rate as the total call volume, as seen by Figure 1. This can be compared to calls regarding encampments, which is another reporting code associated with homelessness. Calls about encampments have increased faster than total call volume. This means that the relative share of 311 calls about encampments has grown, while the relative share of calls

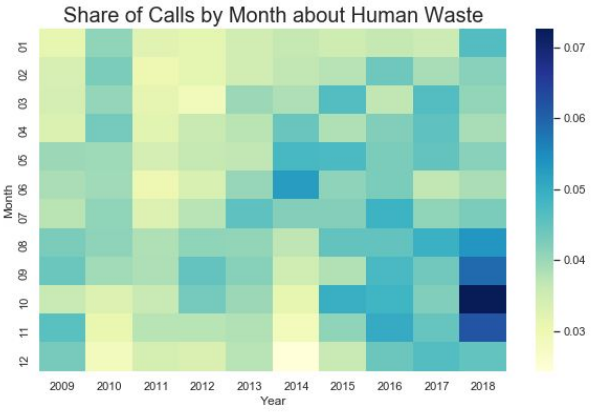
concerning human waste have stayed stable. This indicates that there is perhaps a decreased tolerance for seeing encampments in the city, leading to more calls coming in about encampment cleanups, or that there is less shelter space than there once was, or that there are more people experiencing homelessness in the city. Because the proportion of calls coming in that are related to human waste have remained constant, we must look at how these calls are distributed in more detail.



(a)



(b)



(c)

Figure 2: Calls broken down by year and by month, for total 311 calls, share of calls regarding human waste, and share of calls about encampments.

Figure 2 also shows how call volume has been changing by month by year. This is interesting because we can see if there are seasonal trends as to when calls are coming in. There do not appear to be strong seasonal trends across years for total 311 calls, calls concerning encampments, or calls concerning human waste. Figure 2 also further illustrates that there has not been a significant change in the proportion of calls that are about human waste. Figure 2a shows the total number of calls coming in by month and year. There is a very clear gradual increase in total 311 calls coming in over the 9 year period. Figure 2b shows the percentage of calls coming in that are requests for encampment cleanups. Figure 2b clearly shows a sharp increase in the percentage of all calls that are about encampments between 2015 and 2016. Between these two years, calls requesting encampment cleanups nearly triple (going from approximately 2% of all calls to 6% of all calls). By July and August of 2018, we see that around 12% of all 311 calls during those months were requests for encampment cleanups.

This is contrasted by Figure 2c, which shows share of calls about human waste. We can see that there is month to month and year to year fluctuation, but overall there is no emergent pattern in relative share of calls that are requests for human waste disposal. These findings solidify the idea that calls about encampments are increasing more quickly than calls about human waste, meaning that either there are more encampments in areas where they are likely to be reported, or there is less tolerance for encampments amongst those doing the reporting.

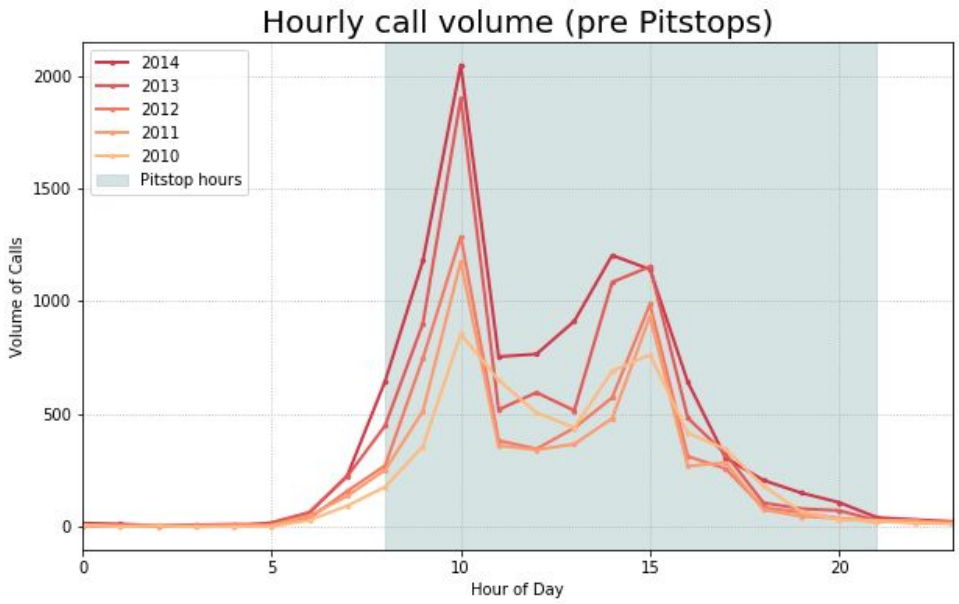


Figure 3: Aggregate calls for the years before the Pitstop program, by hour, with hours of Pitstop program operation in blue-grey.

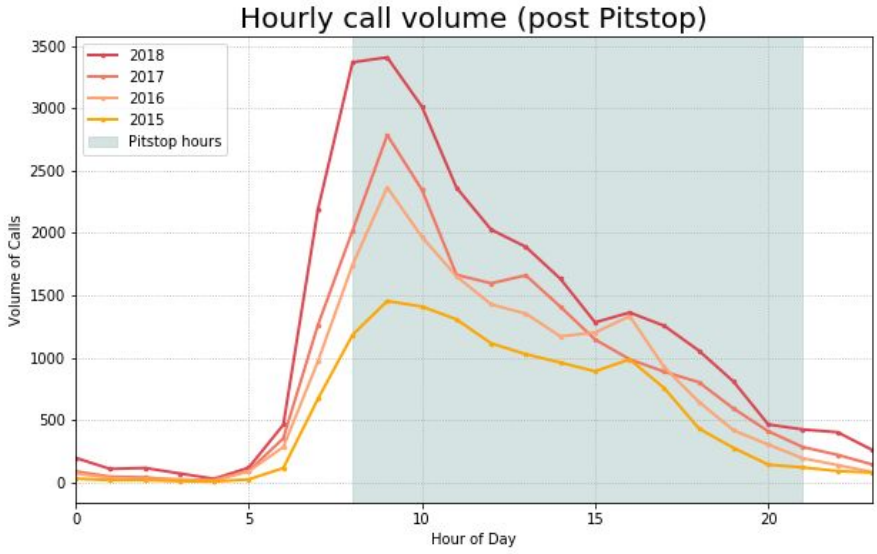


Figure 4: Aggregate calls for the years before the Pitstop program, by hour, with hours of Pitstop program operation in blue-grey.

When we look at how calls come in by the hour, we see something interesting. Figure 3 shows total call volume by hour by year before the Pitstop program was implemented in full, including 2014, which was when the program was being implemented. Figure 4 shows total call volume by hour by year after the Pitstop program was fully active. We can clearly see that before the restrooms were put in, there were typically two spikes in calls, one at around 10 a.m. and a smaller one at around 3 p.m. After the program was implemented, we see a change in pattern. In the years after program implementation, there is one distinct peak around 8 a.m. and a steady decline as the aggregate day gets later. This change hourly call volume suggest that the implementation of the Pitstop program did something to alter temporal reporting patterns.

Spatial Analysis

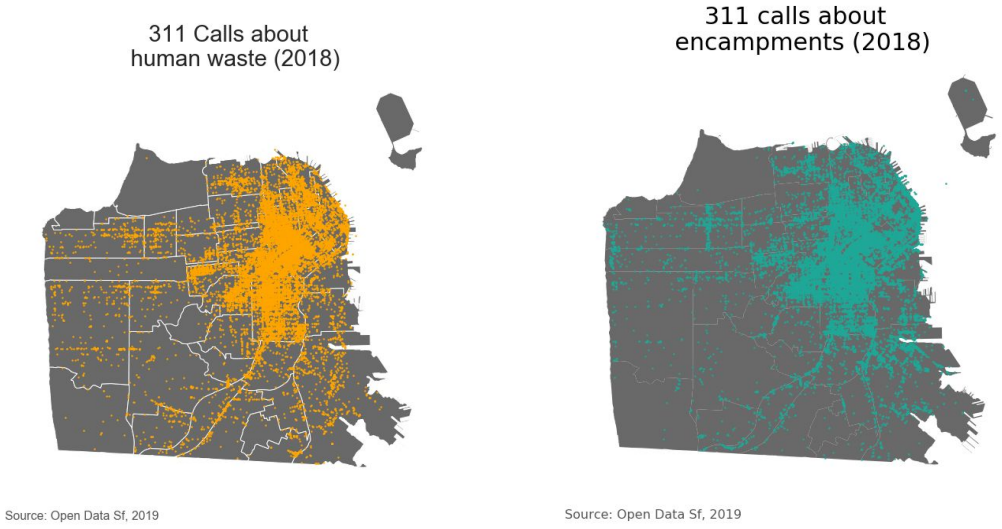


Figure 5: Maps showing case locations of 311 calls in 2018 regarding human waste and regarding encampments.

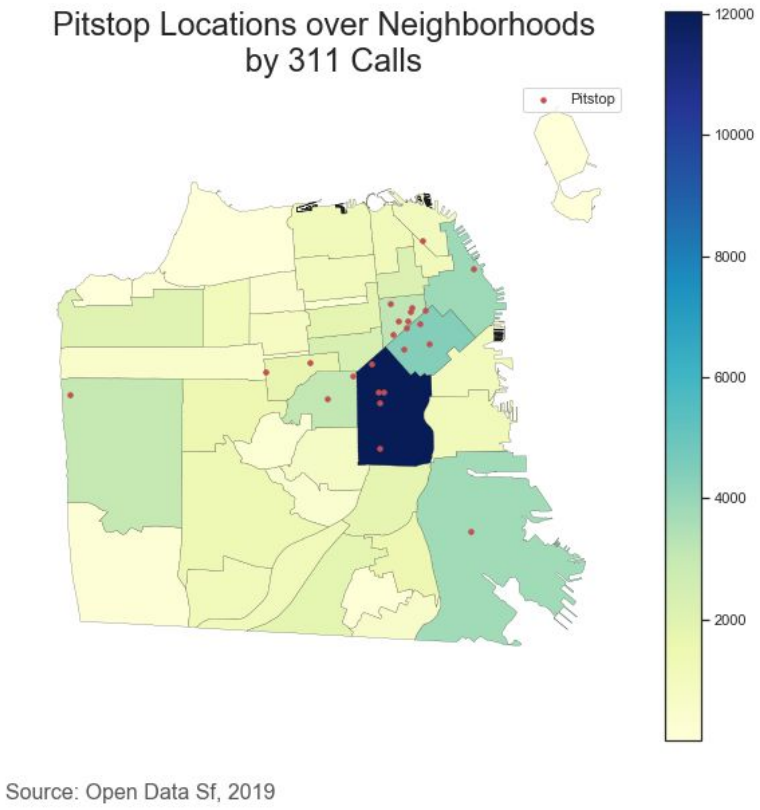


Figure 6: Locations of Pitstops over choropleth map showing number of calls in each neighborhood

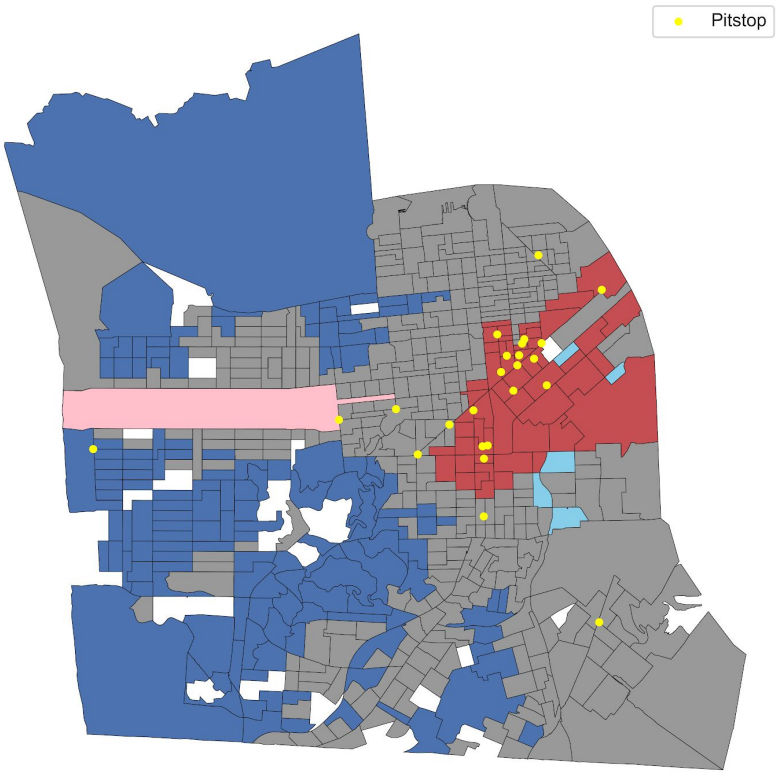


Figure 7: A plot of LISA quantiles where blue blocks are Low-Low clustering, red are High-High clustering, light blue are Low-High outliers, and pink are High-Low outliers. The global Moran's I=0.62437.

Of the 542 blocks where human waste calls occured in 2018, there was an average of 52.254 calls. The median number of calls was 13. There were 47 blocks that only received one call during the year. This indicates that our data for calls by block is heavily skewed right, meaning there are blocks with significantly more calls than the majority. The block with the highest number of calls in 2018 had 1039 calls, which averages to about 2.5 calls per day.

Figure 7 shows the computed Moran's I for human waste reports from 2018. With a p-value of 0.001, we can reject the null hypothesis that the dataset is not spatially autocorrelated and accept that there is global autocorrelation for human waste calls. Our LISAs plot, Figure 7, shows in clustering of high quantities of calls regarding human waste in the northeast region of the city, around the SoMa and Tenderloin neighborhoods. The western half of the city shows clustering of low call volumes. There are a few spatial outliers surrounding these clusters. In the western half of the city there is an outlier that has unusually high call volumes despite being surrounded by low call volume blocks. This is the block that represents Golden Gate Park, a large public park similar to New York's Central Park. There are also some peripheral blocks next to the clusters of high call volume in the Mission area that have low call volumes relative to their neighbors. This shows there are definite hot spots and cold spots for human waste that we might be able to model with a geographically weighted regression.

```
REGRESSION
----------
SUMMARY OF OUTPUT: SPATIALLY WEIGHTED TWO STAGE LEAST SQUARES (HET)
-----------------------------------------------------------------
Data set            :  acs_blocks
Weights matrix      :       queen
Dependent Variable  :hw_calls_2018               Number of Observations:         358
Mean dependent var  :     75.1508               Number of Variables   :           9
S.D. dependent var  :    134.3340               Degrees of Freedom    :         349
Pseudo R-squared    :      0.8484
Spatial Pseudo R-squared:  0.8202
N. of iterations    :           1               Step1c computed       :          No

------------------------------------------------------------------------------------
            Variable     Coefficient       Std.Error     z-Statistic     Probability
------------------------------------------------------------------------------------
            CONSTANT     -44.9634881       9.3391892      -4.8144959       0.0000015
       pct_plumb_not      51.1970797      64.0453492       0.7993879       0.4240655
  Total vacant units       0.0601884       0.0578630       1.0401868       0.2982531
           fire_calls      0.0092216       0.0115498       0.7984233       0.4246249
     total_311_calls       0.0568299       0.0107139       5.3043177       0.0000001
     total_enc_calls       0.0157937       0.0272323       0.5799604       0.5619413
       hw_calls_2013       0.1395499       0.0687537       2.0297061       0.0423864
         pop_density       0.0003777       0.0003453       1.0937073       0.2740834
     W_hw_calls_2018       0.2751963       0.0610828       4.5052981       0.0000066
              lambda       0.3572691       0.1114843       3.2046595       0.0013522
------------------------------------------------------------------------------------
Instrumented: W_hw_calls_2018
Instruments: W_Total vacant units, W_fire_calls, W_hw_calls_2013,
             W_pct_plumb_not, W_pop_density, W_total_311_calls,
             W_total_enc_calls
================================= END OF REPORT =====================================
```

Figure 8: Result of the spatially weighted two stage least squares regression.

Because all Lagrange Multipliers were significant, I chose to create a generalized method of moments model to explain human waste calls. Figure 8 shows the summary of this regression. The regression produced a spatial pseudo r-squared of 0.8202, meaning approximately 82% of the variation in human waste case location can be explained by our model. The most significant factors in our regression were total 311 calls in a neighborhood, 311 calls in 2013, and the spatial weight for 311 cases. This means that strong predictors for where human waste cases will be reported are where other 311 cases are being reported, where cases in 2013 were reported, and

where other cases are being reported. This makes some intuitive sense; this seems to indicate that incertain areas, there are more likely to be reports. This either indicates that in some areas, there are people that are more likely to make reports, or that some areas have more disorder and therefore more incidents to report.

Discussion

This analysis shows that there are strong temporal trends across any given day and strong spatial autocorrelation for human feces complaints. This means that people are more likely to report human waste clean up sites during between 7 a.m. and 9 p.m. in the Tenderloin and the SoMa neighborhoods. There are many possible explanations for these trends, some of which I will discuss in this section.

Temporal analysis using 311 calls is difficult considering the time associated with each datum is when someone reported seeing human feces, not when the production of said feces occured. At night, when the Pitstop locations are closed, people who would be reporting human waste incidents are at home. This means that when people are commuting to work and active in the morning, they see waste that accumulated overnight when the restrooms were unavailable, and call to report this accumulated waste. This is one possible explanation of the spike in call volume we see in Figures 3 and 4, and could be tested by extending Pitstop hours into the night, ideally so that some located at the centers of hotspots are open 24/7, and seeing what effect this policy change has on call volume. Given this explanation, I recommend that the Department of Public Works extend the hours of the existing Pitstop locations or open more locations in the neighborhoods where there are feces hot spots.

Additionally, deploying additional programs or giving more funding to existing programs that serve to combat homelessness could be an effective way of remove human waste from the streets of San Francisco. Most people, when afforded the opportunity, will chose to use a restroom over relieving themselves outdoors. The most obvious solution to a human waste problem is to ensure that all people have access to restrooms at all times, be it through an extensive public restroom network, or through private restrooms. Giving additional resources to effective programs designated to transition those living outdoors to living indoors could be another way to mitigate human feces on the street.

Ideally, I would have included data for 911 calls directed to police department precincts as well as 911 calls directed to the fire department. The city of San Francisco releases 911 call data, but it is not georeferenced and the address associated with each call were not such that I could geocode them. I decided to leave this dataset out of my analysis because I could not aggregate that data to the block level. Future analysis may be done using police districts as the unit of analysis to allow for 911 data from the SFPD to be included.

Future analysis of human waste should include a time series analysis to see how the clusters of human waste calls are moving on a more granular time scale and spatial unit to determine whether fixed restroom locations are ideal to combat waste issues. Sociological research with those experiencing homelessness to see if they find the Pitstop program to be effective should also be conducted. It may also be worthwhile to survey San Francisco residents to see which demographics participate in 311 and where they live. It may be useful to see if some demographics or residents of some neighborhoods are more likely to participate in 311 reporting, and to consider that when looking at where to implement more Pitstops.

Additional analysis of the Pitstop program's effectiveness may also include 311 calls regarding needles found on the street. The Pitstop program includes safe needle disposal sites, so it would be interesting to see if the implementation of the program coincides with changes in call patterns about needle disposal. The Department of Public Works did not make specific claims about removing needles from the street, so I chose not to look at that data in this analysis. It may also be worthwhile to look at public health data, such as cases of shigella or E. Coli to see if variation in occurances of these bacteria is related to where there are high incidents of human waste on the streets.

Sources

Applied Survey Research. San Francisco 2017 Homeless Count & Survey: Comprehensive Report. San Francisco Department of Homelessness and Supportive Housing. http://hsh.sfgov.org/wp-content/uploads/2017/06/San-Francisco-PIT-Executive-Summary-FINAL-6.21.17.pdf . Accessed Apr 6, 2019.

City and County of San Francisco. Mission and Vision. SF311. https://www.sf311.org/web/guest/vision-and-mission. Accessed Dec 10, 2017.

Hwang, S. Homelessness and health. *Canadian Medical Association Journal.* 2001;164(1):229-33. http://www.cmaj.ca/content/cmaj/164/2/229.full.pdf. Accessed Apr 6, 2019.

JCDecaux North America. Advertising in San Francisco. JCDecaux North America. http://www.jcdecauxna.com/street-furniture/san-francisco/advertising-san-francisco. Accessed Apr 6, 2019.

Knight H. Despite money and effort, homelessness in SF is as bad as ever. *San Francisco Chronicle*. Sept 7, 2017. http://www.sfchronicle.com/aboutsfgate/article/Despite-money-and-work-homelessness-in-SF-as-bad-11242946.php Accessed Apr 6, 2019

Knight, H; Fagan, K. S.F. Spends Record $241 million on homeless, can't track results. *San Francisco Chronicle.* Accessed Apr 6, 2019 http://www.sfchronicle.com/bayarea/article/S-F-spends-record-241-million-on-homeless-6808319.php?t=b4c560ad2dbaa6eec6 . Accessed Apr 6, 2019

San Francisco 311. 311 Cases. Data SF. https://data.sfgov.org/City-Infrastructure/311-Cases/vw6y-z8j6. Accessed Jan 14, 2019

San Francisco Department of Public Health, San Francisco Mayor's Office of Housing and Community Development, and the Planning Department. Analysis Neighborhoods 2010 Census Tracts Assigned to Neighborhoods. Data SF. https://data.sfgov.org/Geographic-Locations-and-Boundaries/Analysis-Neighborhoods-2010-census-tracts-assigned/bwbp-wk3r. Accessed Dec 5, 2017.

San Francisco Public Works. Pit Stop Locations. DataSF. https://data.sfgov.org/Health-and-Social-Services/Pit-Stop-Locations/2gny-9qcr/about. Accessed Nov 30, 2017.

San Francisco Public Works. The Pit Stop Story. pitstop. https://sfpublicworks.wixsite.com/pitstop Accessed Nov 30, 2016.

"Shigella Infection." *Mayo Clinic*, Mayo Foundation for Medical Education and Research, 4 Aug. 2018, www.mayoclinic.org/diseases-conditions/shigella/symptoms-causes/syc-20377529.