# A Ward-Level Analysis of Chicago's 311 Service Request System

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**Abstract**

Municipal 311 service request systems emerged in the US during the last 20 years to reduce the volume of non-emergency calls handled by 911, and to promote citizen engagement and data-informed decision-making in government. Recently, cities have begun to make 311 service request data publicly available, increasing citizen access and government transparency. This thesis uses the Chicago Open Data Portal to analyze variation in the number of 311 service requests (SRs) completed in Chicago wards from 2012 to 2018, and found that variation in SRs is associated with population change, racial demographics, housing composition, crime levels, and business licenses.

## Introduction

During the 1990s, urban areas in the United States experienced especially high volumes of nonemergency calls being directed to local 911 operators, which inhibited the ability of these operators to quickly respond to emergencies (Wiseman, 2014). In an effort to reduce the volume of nonemergency calls overwhelming 911 call centers, in 1997 the Federal Communications Commission designated "3-1-1" as the universal nonemergency service request phone number throughout the US for residents in urban areas to request/report nonemergency services (Federal Communications Commission). Following this designation, in 1999, Chicago became the first major city in the US to implement a comprehensive customer relationship management 311 system that provides residents with a one-stop resource to report issues, request information, and request nonemergency police and city services (City of Chicago, 2010-2019). In the more than 20 years since the FCC designation, over 300 city and local governments have implemented 311 service request (SR) systems in the US (O'Brien, 2016). Additionally, Chicago recently modernized the 311 system, which was implemented in December 2018, and includes a mobile

application and real-time data and maps showing residents the location and status of all service requests in the city (City of Chicago, 2019).

Since the 1997 FCC designation, the implementation of 311 SR systems has changed the way city services are requested and delivered by providing residents with a centralized source to refer to when city services or information is needed, and by providing government officials with actionable data on local demand for services and departmental performance metrics. Further, the implementation of 311 SR systems helped reduce the volume of nonemergency calls going to 911, and therefore improved 911 response performance as a result (Wiseman, 2014).These are just a few tangible benefits that have led Chicago and dozens of cities to embrace and invest in 311, however, research has shown that 311 systems also provide numerous intangible benefits, such as increased trust in government on the part of residents, who, upon successfully requesting a service/information through 311, are now more likely to contact and trust government moving forward. When combined, the tangible and intangible benefits provided by 311 systems function to improve community conditions, local government performance, and resident access to and trust in government (Fleming, 2017).

In the last 10 years as digitization and e-government have been trending across the US, many cities have publicly released data on 311 service requests, such as New York, Chicago, and Washington DC, among many others (Kontokosta et al. 2017). The publicizing of 311 data has given residents increased access and transparency regarding the number, type, location, and status of SRs in their area, as well as providing academics with high volumes of actionable data which has been analyzed in a number of ways. As a result, the body of research on 311 systems in the US has expanded considerably since 2010, with many studies being conducted with 311 data covering topics ranging from analyzing 311 use and socioeconomic indicators to identify

service demand information on urban locations, to creating predictive models to optimize 311 delivery (Wang et al., 2017 and Kontokosta et al., 2017).

From 2012 to 2018, the period of this study, Chicago was under the Mayoral administration of Rahm Emanuel, who also oversaw a multi-million-dollar modernization of the 311 system in the city. During this time period, Chicago faced a number of high-profile crises including public teacher strikes, policy brutality and subsequent protest, and the closure of 50 public schools, the most to ever be closed at once by a US city. Generally, Mayoral Emanuel emphasized capital-intensive development near the urban core, while not spending as much time on addressing neighborhood issues (Black, 2019). In this way, the period from 2012 to 2018 is representative of a regime of entrepreneurial urban governance as described by Geographer David Harvey in 1989. This form of urban governance is defined by government seeking to incentivize private investment in and partnership with the city, as well as a privatization of public city functions (Harvey, 1989). By awarding the contract for the modernization and project management of the 311 system to tech-giant Salesforce, the Emanuel administration remained true to his governance style by partially outsourcing this public service (Johnson, 2018).

This thesis builds on the recent body of research by using the Chicago Data Portal to analyze historic 311 datasets for the 11 most popular service request types. The analysis was conducted at the ward level, which are the 50 jurisdictions in Chicago that elected representatives on City Council, and the time period for this study was 2012 to 2018, which are the years of information available that align to the current ward boundaries (Chicago Board of Election Commissioners, 2012). The goal of the thesis was to identify factors associated with variation in the number of SRs completed in Chicago wards, and Independent variables such as

voter information, housing composition, racial demographics, crime levels, business licenses, and population change were analyzed.

## Literature Review

In a 2014 study of US 311 systems, Jane Wiseman conducted a comprehensive review of 311 in Chicago and New York City, wherein the design and implementation, results and impact, and success factors associated with these systems was analyzed. The 311 system in Chicago was introduced to reduce the volume of nonemergency 911 calls slowing down emergency call centers, to provide a tool to track and improve performance in city departments, and to improve the quality of city service provided to residents (Wiseman 2014, pg. 13). To accomplish these goals, Chicago contracted Motorola to custom build a citizen/customer relationship management (CRM) system that would function to receive 311 requests from residents and internally track city responses, first via phone or in person at community policing centers or aldermanic offices and later via the web. The City decided to house the new 311 system, call center and staff in the Office of Emergency Management and Communications, which houses the City's 911 operations. The 311 system was established with full operational capability to function as a backup 911 call center (Wiseman, 2014).

During the design of the system, Chicago Aldermen feared that the introduction of a centralized service request system may reduce their ability to directly address resident needs. This fear was rational because Aldermen have historically been the main point of contact between local residents and government for addressing nonemergency city service needs. As such, Aldermen successfully lobbied for the ability of aldermanic staff to input service requests received by residents directly into the 311 system. The decision to allow aldermanic staff to receive and input resident service requests provided considerable benefits, such as the ability for

staff to internally track and analyze service request history within the ward. Citizens were also have access to request services and had the option to do so via phone, online, or in-person (Wiseman, 2014, pg. 17). One question that is worth further investigation is the staffing and procedural organization that exists at aldermanic ward (or constituent) offices to process service requests. For example, if a powerful aldermen has committee funds and campaign funds to hire a large staff, they can potentially improve their ability to effectively process service requests for residents and increase resident trust in the Aldermen as a result.

The results of the implementation of 311 in Chicago have been successful in multiple ways, including: directing of nonemergency calls away from 911; providing support and 311 system access to the Department of Aviation; Transportation Authority; Housing Authority, and Parks Department. The system resulted in a volume of provision of information and services to residents, with nearly 4 million calls received by 311 annually (Wiseman, 2014). In addition to being a fully functional backup for the 911 call center, the 311-call center receives 100,000 nonemergency police calls annually, which it is equipped to handle embedded Alternative Response Officers. *"Chicago 311 offers constituents a variety of ways to connect: phone, web self-service, and text…. however, the most frequent means of contact is phone, with 88 percent of total volume coming through the call center. Of calls received, between 60 and 75 percent are for information only, with the remainder including calls to register a complaint or request a city service." (Wiseman, 2014, pg. 15).* Given the value that the introduction of 311 in Chicago has provided, City officials have invested in the modernization of the system, which includes a mobile-app and real-time data/maps, and was implemented in December, 2018 (City of Chicago, 2018).

In 2017, the International City/County Management Association (ICMA) conducted the first-of-its-kind national study of 311 customer service technology in use by local governments in the US which analyzed the role of centralized citizen/customer relationship management (CRM) systems in the delivery of local city services (Fleming, 2017). This study involved collecting survey data from local governments that have 311 systems to understand how the systems are being used. In total, the survey indicated nearly 60 local governments in the US have implemented 311 systems, with the size of the jurisdiction ranging from populations of less than 20,000 to the largest metro areas in the US, including seven jurisdictions with populations larger than 1 million (Fleming, 2017, pg. 29). One key finding from this research is in regards to the local nature of 311 systems. Because 311 is not federally mandated like 911, state public utilities commissions are tasked with regulating and overseeing these systems at the state-level, which means there are significant variations in the design and operation of these systems among local governments. For example, the use of unique tracking numbers being assigned to each service request is only in use at 71% of the local governments surveyed by the ICMA, and 44% of these systems do not use a single-access number such as 311, but rather have a different number or digital method for request intake (Fleming, 2017, pg. 11, 14).

In addition to analyzing the survey results to determine common themes among local government use and design of 311, the ICMA also used the survey to assess the costs and benefits identified by local governments which they associated with their use of 311 systems. The results of the ICMA analysis indicate there are two distinct types of benefits which are associated with 311 systems: tangible and intangible. Tangible benefits can include those which result in measurable financial benefits, such as cost savings for technology and staff via

consolidation and modernization, process optimization via data analysis of performance, and revenue increases by increasing performance of money-making services (Fleming, 2017).

On the other hand, intangible benefits refer to those benefits which are not as clearly measured or financially impactful, but nevertheless prove invaluable for government and residents alike. Specifically, intangible benefits provided by 311 systems include increased trust toward, and an increased likelihood to contact local government as a result of the successful response to a service request submitted by a resident, who, upon having their request completed, has developed a more positive view of the local government. Finally, other intangible benefits include improved community conditions and enhanced government availability and accountability to residents (Fleming, 2017).

As the public release of 311 data becomes more ubiquitous, scholars are analyzing the data to make observations and recommendations. To better understand the conclusions that can be drawn from analyzing 311 data, Ariel White and Kris-Stella Trump wrote a 2017 research paper that sought to understand the meaning of 311 data, and if it can be used to assess political participation (White and Stella-Trump, 2017). In attempting to confirm or deny the validity of using 311 data to indicate political participation, White and Stella-Trump compare 311 data to other political participation indicators to assess if similarities exist.

The results of this comparison feature a number of key findings, such as the fact that 311 calls are negatively related to election turnout and returning census forms, which leads the authors to conclude that 311 data cannot be used to measure political participation. However, White and Stella-Trump were able to determine that 311 data can be used to identify neighborhood-level demand for city services. Specifically, they determine that, "…311 data are by definition a measure of neighborhood-level realized demand for services and provide

information about the relative intensity with which different parts of the city vie for the attention of the government." (White and Stella-Trump, 2017, pg. 19). This finding is especially important in informing this thesis by confirming that 311 data can be used to measure local demand for city services because this thesis uses 311 data to measure local completion of service requests, and these request completions are informed by local demand. This thesis finds that ward-level demand for services (as measured by number of completed SRs) varies among wards, and that different types of SRs are related to different factors that cause high or low completion rates.

Wang et al., used 311 data and socioeconomic data in three cities to from 2012 to 2015 and compared it to socioeconomic and demographic indicators to identify clusters of urban locations where the nature and volume of 311 use is related to a set of socioeconomic indicators (Wang et al., 2017). Census data from the 2014 American Community Survey was used to consider racial demographics, education, poverty, employment, and other factors, and, Zillow housing prices were also used to assess local economic well-being (Wang et al., 2017). This study provided evidence from multiple cities that shows a consistent connection between particular socioeconomic factors and 311 use profiles, which is especially difficult given the local context in which 311 systems operate.

Wang et al. 2017 classify four clusters of urban locations which exist in New York City, Boston, and Chicago. The strongest relationships between socioeconomic factors and 311 SRs were found to exist with wealth, education levels, unemployment, racial demographics, and housing prices, and these relationships were used to develop a predictive model of socioeconomic patterns across urban locations (Wang et al., 2017). It is unclear if this model has been formally adopted by municipalities.

The four clusters which are identified each have unique socioeconomic and 311 use profiles: cluster 1 had high 311 use for noise complaints and high median income, large white populations, and advanced education levels; cluster 2 had high 311 use for tree reports, street light reports, and street condition reports and high Asian population and especially high education levels; cluster 3 had the highest overall 311 use, with sanitation violations, plumbing issues, and heating issues being reported the most, and this cluster has high unemployment levels, high African-American populations, and high levels of poverty; and, cluster 4, which has high levels of blocked driveway and illegal building use reports and has high uninsured rates and large white populations (Wang et al., 2017, pg. 6, 9).

This research produced by Wang et al. 2017 is the most foundational piece of scholarship on which this thesis was developed because it identified a connection between socioeconomic factors and 311 use profiles which can be used to identify unique urban locations. The results of the research by Wang et al., indicate that 311 data, when combined with other indicators, can be a valuable tool for better understanding specific locations in cities and can inform strategies for improved service delivery to specific areas. The methodology and subsequent findings used by Wang et al., prompted this thesis to compare 311 data with socioeconomic and other factors to better understand urban spaces in Chicago, and how 311 use profiles vary in relation to these socioeconomic factors.

Given the fact that some of the research methods used by Wang et at. Prompted this thesis to use similar methods, and that both studies consider Chicago as a subject, the results of each are compared briefly. First, the spatial location of Cluster 4 identified by Wang et al., aligns with the location of the wards which completed more than 70,000 SRs identified in Appendix C – Map A herein. Additionally, the analysis conducted by Wang et al. shows a relationship

between 311 use profiles (SR types, frequency of use) and racial demographics, which is also observed in this thesis in the crosstabs, which show white, Hispanic, and Black populations to be related to SRs when graffiti removal is included.

In a similar research paper, Kontokosta et al. also analyze the relationship between socioeconomic and demographic factors and 311 requests to develop a predictive model of service requests that accounts for bias against certain groups. The methods used statistical modeling of likelihood of building violations and compared this information to actual 311 reports for those violations to identify gaps between expected and actual reports. These gaps were then observed in relationship to local socioeconomic profiles which determined which groups were more or less likely to report problems via 311(Kontokosta et al., 2017).

The findings of this research indicated that areas with lower than expected 311 use have socioeconomic profiles that feature a high population of male residents, racial minorities, high unemployment, and high levels of limited English proficiency. The findings also indicate that areas with higher than expected 311 use have socioeconomic profiles which feature high populations of female residents, white and Asian residents, high education levels, and high population of elderly residents (Kontokosta et al., 2017, pg. 5). Based on the profiles developed, the authors created a predictive model that can facilitate more efficient resource allocation by giving more consideration to under-reporting areas in order to increase 311 SRs. The study does not indicate if this model was adopted. Further, the relationships between racial demographics and 311 use observed by Kontokosta et al. were not verified by this thesis, which found that 64% of wards with above average Asian populations had below average SR completion (Crosstab B).

Another critical contribution to the field of 311 research is a 2016 study by Daniel Tumminelli O'Brien which analyzed how 311 systems represent shared engagement in city

improvement between residents and government. This study involved analyzing three separate factors in 311 use: (1) proximity of 311 users to their residence; (2) introduction of mobile app for 311 reporting; and, (3) the use of promotional materials to increase 311 use. These three cases were analyzed to determine if 311 use is related to a sense of ownership or territoriality that makes residents participate in neighborhood improvement. Importantly, this research argues that 311 use is a representation of an observed human propensity to demonstrate territorial behavior, or, to engage in the maintenance and improvement of the area they live in due to a sense of ownership (O'Brien, 2016). The findings of each case-study in these research are significant contributions to the field of 311 analysis because each case validated the 'territoriality thesis', which suggests 311 use will be higher near areas of the users' residence.

Specifically, case study 1 found that the majority of 311 reports were submitted in an area within very close (no more than a few blocks) proximity to the residence of the person who submitted the request. Case study 2 analyzed the effects of introducing a mobile app with 311 reporting capability to see if this more accessible/convenient reporting method would expand the spatial range at which issues were reported. This case study showed that 311 users who reported via the mobile app did so within an expanded spatial area compared to those who called '311', though, this area was still contained to a relatively small neighborhood, suggesting territoriality remains a factor with new technology. Finally, the third case study tested various language on promotional material for the 311 system, and found that advertisements which referenced specific local or neighborhood characteristics increased 311 use by a substantial margin compared to more neutral language promoting use of the system (O'Brien, 2016, pg. 136). Taken together, these case studies suggest 311 use is driven by a sense of ownership of space, where

311 is the tool that allows for residents to participate in the improvement of space by requesting city services.

**Research Statement and Methods**

311 service request systems provide critical services and access to information to residents, and create benefits for neighborhood conditions, government performance, and positive citizen-relationships with government (Fleming, 2017). The study of 311 data has shown that this information provides an accurate measurement of local demand for services and citizen-initiated communication with government, and, that 311 use is related to local socioeconomic factors (White and Stella-Trump, 2017, and Wang et al., 2017). This thesis sought to contribute to the body of research on 311 systems and data by assessing the completion of service requests in Chicago at the ward-level, which is the most mature 311 service request program in the US (City of Chicago, 2019). This thesis analyzed the number of 311 service requests (SRs) completed in Chicago wards from 2012 to 2018 using publicly available data from the Chicago Data Portal. The goal of this thesis was to identify factors associated with variation in the number of SRs completed at the ward-level by comparing socioeconomic, political, and spatial indicators to levels of SR completion. Completion indicates the 311 department made a determination on the request which resulted in an action, and does not include open or duplicates.

Previous research (D'Onofrio, 2018) has shown that variation in 311 SR completion levels in Chicago exists, and that it is associated with ward-level criminal activity, and voting profiles. Specifically, D'Onofrio conducted a cross tabulation of 311 SR completion (from 2011 to 2017, only Rodent, Pot hole, and Garbage SRs) and business licenses, voter registration, arrests, and ward-population, and found arrests to be negatively associated with SR completion,

while voter registration indicated strong positive relationship (2018). The findings of this previous research informed the development of the following hypothesis which are tested in this thesis:

- Hypothesis 1: the number of 311 service requests completed in Chicago wards will vary substantially from the lowest to highest completion levels.
- Hypothesis 2: variation in the number of 311 service requests completed among Chicago wards will be associated with social and political factors, such as crime and voting levels.

In order to assess 311 SR completion in Chicago wards, the Chicago Data Portal was used to obtain data on service requests from 2012 to 2018. The Data Portal has 11 historical datasets which include ward-level 311 SR data for these years, and these datasets are categorized by service request type (See Appendix B for SR types). The number of SR completions by ward was added from the 11 datasets to create a sum of SR completion for each ward. This sum functioned as the dependent variable in this thesis. There were six categories of independent variables which were used to test for association with variation in SR completion among Chicago wards (Refer to Appendix E - Variable Definitions for complete list). These variables included publicly available data on racial demographics, housing composition, voting information, crime levels, and business license information, all of which were measured at the ward level. A control variable of the most recent population data was also used to test for association between ward population and SR completion.

The methods used to analyze variation in SR completion included both spatial analysis and data analysis. The first step was to conduct data gathering to combine each of the ward-level SR totals from the 11 datasets of different SR types and to create a map to present the data visually (See Appendix C, Map A). This map visualized the distribution of SR completion in a way

which allowed for the comparison to existing maps of Chicago, such as demographic, crime, and zoning and housing maps.

Crosstab analysis was selected as the method of analysis because it determines the relationship between two variables by testing how often they combine when coded in certain ways. Specifically, a crosstab is a table with an X row and Y column that each represent the distribution of a given variable, and the crosstab table assesses the frequency that specific combinations of variables occurred. For example, in this thesis, the X row was the Dependent variable of SR completion, and the Y column was used to test a variety of independent variables, such as number of arrests. The crosstabs in this thesis assessed how often "above average" SR completion and "below average" SR completion combined with above and below average distributions of other variables by recoding the variables. If the relationship observed is significant, then it will either be positive or negative. Positive relationships in this thesis indicate that above average Independent variable numbers and combined with/related to above average Dependent variable numbers, meaning more of Y is related with more of X, while negative relationships mean that above average Independent variable numbers is related with below average Dependent variable numbers.

This data analysis involved re-coding all variables to a 1 (below average) or 2 (above average), and cross-tabulations were run which tested the level of association between 22 unique indicators and the dependent variable (See Appendix D, Crosstab A). The results of the first round of cross-tabulations did not produce expected outcomes, and upon further analysis, it was determined that one of the 11 SR types (Graffiti removal) was having an outsized impact on the results, so the decision was made to remove this SR type from the sum of ward-level SR completion used as the dependent variable.

After removing graffiti SRs from the ward-level total, another map was created to show the distribution of 10 of the 11 types of SRs, and the cross-tabulations were run again (See Appendix C, Map B, and, Appendix D, Crosstab B). The results of the second round of cross-tabulations produced results which aligned with expected outcomes, and no additional data analysis was conducted. Finally, to effectively summarize the results, two maps were created that only included select-wards which were explanatory/representative of the results. The first map showed the wards in which Graffiti Removal SRs accounted for 50% or more of total SRs from 2012 to 2018, and the second showed the wards with the highest and lowest number of completed SRs when Graffiti is not included (See Appendix C, Map C and Map D).

Lastly, a number of key decisions were made in the research process that shaped the scope and nature of this thesis and require further explanation. Critically, the decision was made to conduct this study using Chicago's 50 wards as the spatial measurement because these wards are the connection between residents and city government representatives (aldermen). Ward offices can process 311 requests directly, and elected aldermen are therefore partially responsible for, or should at least be aware of 311 activity in their ward. Another key decision was made to analyze data from 2012 to 2018 because ward boundaries were redrawn in 2012, and 311 data for the year 2019 is not yet complete, so this time period aligned both with boundaries and data availability. The third key decision that was made involved filtering the 311 SR data to only include "Completed" SRs, because these data points indicate the full SR lifecycle from citizen request to government action was carried out, whereas "Open" or "Duplicate" requests are not directly tied to a government action related to a citizen-initiated-contact.

## Analysis

### Service Request Variation

From 2012 to 2018, there were 2,585,981 SRs completed in Chicago, among the 11 most popular SR types, which resulted in a citywide ward-level average number of total completions over this period at 51,720 SRs (See Appendix B, Volume of 311 SRs by Request Type). Among the 11 SR types, Graffiti removal accounted for 32% of the total, which was more than the combined proportion of the two next-largest SR types, Pot holes (13%) and Garbage carts (11%) (See Appendix B, Composition of Service Request Types). Appendix A shows the extent of variation in the number of SRs completed among wards, with the highest ward completion total at 97,846 (14th ward), and the lowest at 22,277 (46th ward), with a gap of over 75,000 SR completions between them. The presence of such a large gap between the highest and lowest ward-level SR completions is concerning as it indicates unequal use of the system by local residents in these wards.

Also shown in Appendix A is the substantial variation in the number of Graffiti removal requests which exists among Chicago wards, with the highest completing 60,058 requests (14th ward), and the lowest completing 1,122 (6th ward), with a gap of over 58,000 Graffiti removal completions between them. Additionally, although 60,058 (14th ward) was the highest number of ward-level graffiti removal requests completed during this time, the 12th and 25th wards both had a higher percentage of their total SR completions made up by graffiti removal (64% and 63%) than the 14th ward (61%), while the 6th and 34th wards only had 2% of their respective total SR completions made up by graffiti removal.

The results of the data shown in Appendix A support hypothesis 1, which argued substantial variation in 311 completion would exist among Chicago wards, and the confirmation of this variation allows for the analysis of factors associated with variation. Further, these results indicate that each service request type, and graffiti removal particularly, is likely associated with

its own set of socioeconomic, spatial, and political factors that are related to variation in completion levels. For example, Appendix C, Map C shows that the wards in which over 50% of SRs were graffiti removal are spatially concentrated on the near northwest and southwest sides of Chicago, and, the data analysis indicates that the factors which are associated with variation in SR completion change when graffiti is removed from the total (Appendix D).

**Spatial Analysis**

In regards to the maps created for the spatial analysis in this thesis, there are a number of observations worth discussing at length (refer to Appendix C for Maps). Starting with Map A, which shows SR completion for all request types, the 11 wards which completed the least number of SRs, less than 40,000, are concentrated along the Lakefront, with only 2 wards in this group not directly on the Lakefront (29th and 20th wards). Map B, which shows SR completion for 10 of 11 SRs and does not include graffiti removal, indicates that the 8 wards which completed the lowest number of SRs, less than 25,000, remain those located on the Lakefront. In fact, the 5th, 4th, 3rd wards on the South Lakefront, and the 46th, 48th, and 49th wards on the North Lakefront, remain in the group with the lowest SR completion both when graffiti is and is not included. These observations indicate that there are specific characteristics which the Lakefront wards have that reduces the number of service request completion in the area, such as the presence of Lakeshore Drive and the Lakefront Trail and Parks, or the concentration of condominiums in these areas.

When determining which wards have the highest level of SR completion, the fact that graffiti removal accounted for 32% of total SRs is especially significant, and is observed when comparing Map A and Map C. Map A shows all 11 SR types, and indicates that two groups of wards on the near Northwest and Southwest sides of Chicago, a total of 9 wards, had more than

70,000 SR completions. Of particular note in this group are the 14th and 1st wards, which had 97,846 (most) and 85,867 (2nd) SR completions respectively, which exceeded the 12th ward (78,816) by more than 7,000 SRs. However, graffiti removals accounted for 61% of the 14th ward total, and 59% of the 1st ward total (Appendix A). To that end, Map C shows the 8 wards in which 50% or more of the total SR completions were graffiti removals, notably, 6 of the wards in which graffiti accounted for more than 50% of the total also were in the group of 9 wards with the highest SR completion (more than 70,000) when graffiti is included in Map A.

The influence of graffiti removal requests on trying to identify the wards which had the highest number of SR completions motivated the decision to not include graffiti SRs in the ward level total completion number. The results of not including graffiti SRs in the total are shown in Map B and Map D. Both maps show ward-level 311 completions totals that do not include graffiti, though Map D highlights the 8 wards with the highest and 8 wards with the lowest completion numbers. A key observation seen in these maps is the group of 8 wards with the highest 311 completions (more than 45,000) is spatially grouped in the far Southwest side of Chicago. The wards with the lowest 311 completion numbers do not change spatially from the Maps where graffiti was included, and remain on the Lakefront. Also of note is the reduction in variation among SR totals when graffiti is removed. Whereas when it was included, there was a difference of 7,000 SRs between the ward with the 2nd and 3rd most completions, when graffiti is not included, there are 9 wards within a range of 7,000 SRs from the ward with the highest completion number.

## Data Analysis

The association between variation in SR completion and social, political, and spatial factors was tested using cross-tabulation analysis. Service request completions were used as the

dependent variable that first tested as including all 11 SR types (Crosstab A), and then were tested again without graffiti removals (Crosstab B). Independent variables included population, housing, crime, demographic, voting, and business license data (See Appendix E for variables). All variables values were re-coded into 1 or 2, representing being below or above average within the variable dataset. When interpreting the results of the cross-tabulations, positive relationships occur when the increased percentage of the independent variable (IV) is associated with an increased percentage of the dependent variable (DV), and decrease in the IV is associated with a decrease in DV. Negative relationships indicate the increased percentage of the IV is associated with a decreased percentage of the DV or where the IV is decreasing, DV increases.

The results of the first round of crosstabs (Crosstab A), where graffiti is included, indicated 6 positive relationships existed and 5 negative relationships. Specifically, the strongest positive relationship existed with the percentage of Hispanic/Latino residents within city wards and active business licenses. 72% of wards with an above average Hispanic population had above average SR completion numbers, and 72% of wards with a below average Hispanic population had below average SR completion numbers. Similarly, 64% of wards with an above average number of active business licenses had above average SR completion, and 64% of wards with less than the average business license count had less than average SR completion. Additional significant positive relationships observed in Crosstab A include with the population change from 2010 to 2012-2016, which indicates that wards which have gained or lost substantial populations since 2010 will have also increased or decreased the amount of SR completions from 2012 to 2018. Finally, the percentage of white population, and of single family or 2 to 4 unit buildings was also positively associated with SR completion for Crosstab A.

The most significant negative relationships that were observed in Crosstab A include percent of Black population, total crime reports and arrests made. In both cases, 72% of wards with an above average Black population or crime/arrests had below average SR completion, and only 28% of wards with an above average Black population or crimes/arrests had above average SR completion. An equally significant negative relationship was observed in Crosstab A finding that 72% of wards with an above average number of 5+ unit buildings had below average SR completion. The least significant negative relationship indicated that 60% of wards with an above average number of registered voters in the 2015 Chicago municipal general election had below average SR completion.

Crosstab B did not include graffiti removal in the dependent variable and ran all of the same independent variable tests to identify significant associations with variation in SR completions. There were 3 significant positive relationships and 5 significant negative relationships observed in Crosstab B, and while the number of positive relationships fell compared to Crosstab A, the results produced a predictable outcome. Namely, Crosstab B found that 76% of wards with an above average number of single-family homes had above average SR completion, and 76% with a below average single-family home number had below average SR completion. The positive relationship between single family homes and SRs was the most significant result from the entire data analysis. Crosstab B also indicated that 56% of wards with above average voter registration and turnout numbers in the 2015 Municipal General election had above average SR completion. This result is especially notable because not including graffiti shifted the 2015 voter registration variable from being negatively to positively associated with SR completion.

A negative relationship that was observed in Crosstab B showed that 68% of wards with an above average number of 5+ unit buildings had below average SR completion. This result was expected to be the most significant negative relationship due to the requirement that buildings of this size in Chicago receive private waste collection, meaning they do not submit SRs for garbage carts. Other significant negative relationships were observed in Crosstab B with percent of Asian population, number of condominium buildings, and the number of active business licenses. The results of Crosstab B, therefore, indicate that wards in which there is a high percentage of multi-unit buildings (5+ units and condos) generally have lower numbers of 311 SR completion than wards in which there is a high percentage of single family homes, which are likely owner-occupied and receive city waste collection.

This result also represents a case where removing graffiti from the analysis shifted business licenses from being positively associated with SR completions in Crosstab A, to negatively associated in Crosstab B. Also of significance is the fact that the positive relationship with Hispanic and White population, and the negative relationship with Black population that was observed in Crosstab A were not observed in Crosstab B. This suggests that graffiti removal requests are strongly related to these three racial demographic groups, though this is not verified. Finally, the results which were observed in both Crosstab A and Crosstab B support hypothesis 2, which argued that variation in SR completion would be associated with social and political factors such as crime and voting.

## Discussion

The results of the ward-level analysis of Chicago's 311 SR system presented in this thesis provide multiple findings related to variation in 311 SR completion. First, this thesis used seven years of 311 data to identify and analyze variation in the number of SR completions, and found

that graffiti removal requests accounted for an especially significant portion of SRs in Chicago, and that the number and proportion of graffiti requests completed by ward varied. The number of 311 SRs completed in each ward from 2012 to 2018 was found to vary, with a gap of 75,000 SRs separating the highest and the lowest number of ward-level completions. Next, spatial analysis indicated that wards with the highest and lowest number of SR completions were located in specific locations in Chicago, such as low total completion on the Lakefront, high graffiti request levels on the near Northwest and Southwest sides, and high total completion on the far Southwest side when graffiti SRs are not included.

Finally, the results of the data analysis indicated multiple findings, both when graffiti is and is not included. The results of the first set of crosstabs in which graffiti was included indicate that above average SR completion is positively associated with above average Hispanic and White ward-level populations, as well as with population growth, and with single family homes and 2 to 4 unit buildings (Crosstab A). This set of crosstabs also indicated negative associations between high black populations, high crime/arrests levels and SR completions, indicating that there are low numbers of SR completions in high crime areas (Crosstab A). The second set of crosstabs which do not include graffiti removal indicate that the strongest positive association with SR completion exist with single family homes, while the strongest negative association exists with 5+ unit buildings (Crosstab B). Additionally, the associations between the three largest racial groups in Chicago were no longer present when graffiti was not included.

The findings of this research contribute to and expand on the existing body of work studying 311 systems and data cited in the literature review above. First, the connection between socioeconomic factors and 311 SR profiles which was identified by Wang et al., (2017) is a method which was used in this thesis, though the exact associations which were identified in this

thesis were not the same. Another connection which this thesis has to the research conducted by Wang et al., is the spatial grouping of these 311 SR completion profiles and socioeconomic factors, such as the high Hispanic population on Chicago's near North and Southwest sides which this thesis found to be associated with high SR completion numbers. Similarly, this thesis builds off the research conducted by Kontokosta et al., which used socioeconomic data to identify factors associated with high and low 311 system use, and found that each SR type likely has its own set of factors which are associated with high or low use. Lastly, this research verifies some of the findings presented in O'Brien's 2016 study of 311 system use and territoriality because thesis found that the strongest positive associated with high 311 completion was single family homes, which indicates that 311 users seek to improve the area around the home which they own and live in.

**Limitations**

The research conducted for this thesis was limited in a number of ways which will be addressed in future research. First, the most recent population data is from the US Census in 2010, making it almost a decade old for use during this study and, as such, up-to-date ward-level population data could not be obtained for the control variable which sought to determine if number of SR completions is associated with population numbers. Another key limitation faced by this thesis is the lack of availability of a wide variety of data at the ward level. Specifically, key indicators such as health, education, and income statistics are not publicly available at the ward level because most of these indicators are measured with census tracts, zip codes, or community areas. The final limitation in this thesis is that there are only publicly available historical datasets on the 11 most popular SR types included herein, despite the fact that there are multiple dozens of SR types in Chicago's 311 system. As such, the dependent variable of

'Service Requests Completed" is not a comprehensive figure which includes the full array of SRs completed at the ward-level.

## Future Research

This thesis is part of a multi-year research project being undertaken to analyze Chicago's 311 system, and the findings contained herein will inform future research. As discussed in the Limitations section above, there were a number of restrictions on this thesis which will be addressed in future research, such as by obtaining more recent population data from the upcoming 2020 Census, by converting key data indicators to be measured at the ward-level, and by utilizing Chicago's newly released 311 service request dataset that includes every SR type. In addition to directly addressing the limitations encountered in this thesis, future research will also expand upon the scope and findings in this thesis.

First, future research will include analysis of individual SR types, such as graffiti removal or garbage carts, to assess the distribution of and factors associated with each, because the analysis in this thesis indicated each SR type is associated with a unique set of factors. Second, future research will include a comparison of the maps of 311 SR completion produced herein with other maps of Chicago which show racial demographics, housing composition, and zoning laws, in order to visualize relationships between SR completion and other factors. For example, Steven Vance recently produced a map of Chicago's zoning laws which indicates that 41% of the city's zoned-land-area is zoned exclusively for single family houses (Vance, 2019). Additionally, future research will seek to incorporate additional spatial variables such as population density, miles of street and alleyway, and number of special facilities such as industrial areas, medical centers, or university centers, which may be associated with less SR completion. Lastly, future research will involve conducting interviews with subject matter experts on 311 systems and data

who can provide feedback on this thesis and inform the creation of recommendations for more equitable and efficient operation of Chicago's 311 system.

## Conclusion

This thesis used publicly available data on the most popular 11 types of 311 SRs in Chicago to determine what factors are associated with variation in the number of SRs completed in Chicago wards. The methods used to test the research question involved creating maps for spatial analysis, and conducting crosstabulations for data analysis, and the time period of study was from 2012 to 2018. The maps created for this thesis showed that the wards with the lowest SR completion numbers were consistently located along the Lakefront, while the wards with the highest number of SR completions varied based on which SR types were included. Graffiti removal was found to account for 32% of all SR completions from 2012 to 2018, with ward-level completions varying from 1,000 to 60,000 cases. There were 8 wards in which graffiti removal was found to account for over 50% of total SR completions from 2012 to 2018, all of which were concentrated on the near Northwest and Southwest sides of the city, and when graffiti was not included, the wards with the highest number of SR completions were located in the far Southwest side of the city.

The data analysis showed that associations between SR completion and independent variables change based on the inclusion or non-inclusion of graffiti removal requests. When graffiti is included, Hispanic/Latino population, business licenses, and population change were the most significant positive associations with SR completion, while Black population, arrests/crime, and 5+ unit buildings were the most significant negative associations with SR completion. When graffiti was not included, single family homes and 2015 voter registration and turnout were the most significant positive associations with SR completion, while 5+ unit

buildings, Asian population, and condominiums were the most significant negative associations. These findings indicate that housing composition and racial demographics are strongly associated with SR completion, and contribute to the larger body of research on 311 systems and data by expanding upon the relationship between socioeconomic factors and 311 data. Future research will seek to identify strategies and solutions to improve Chicago's 311 system for residents and government based on the findings in this thesis.

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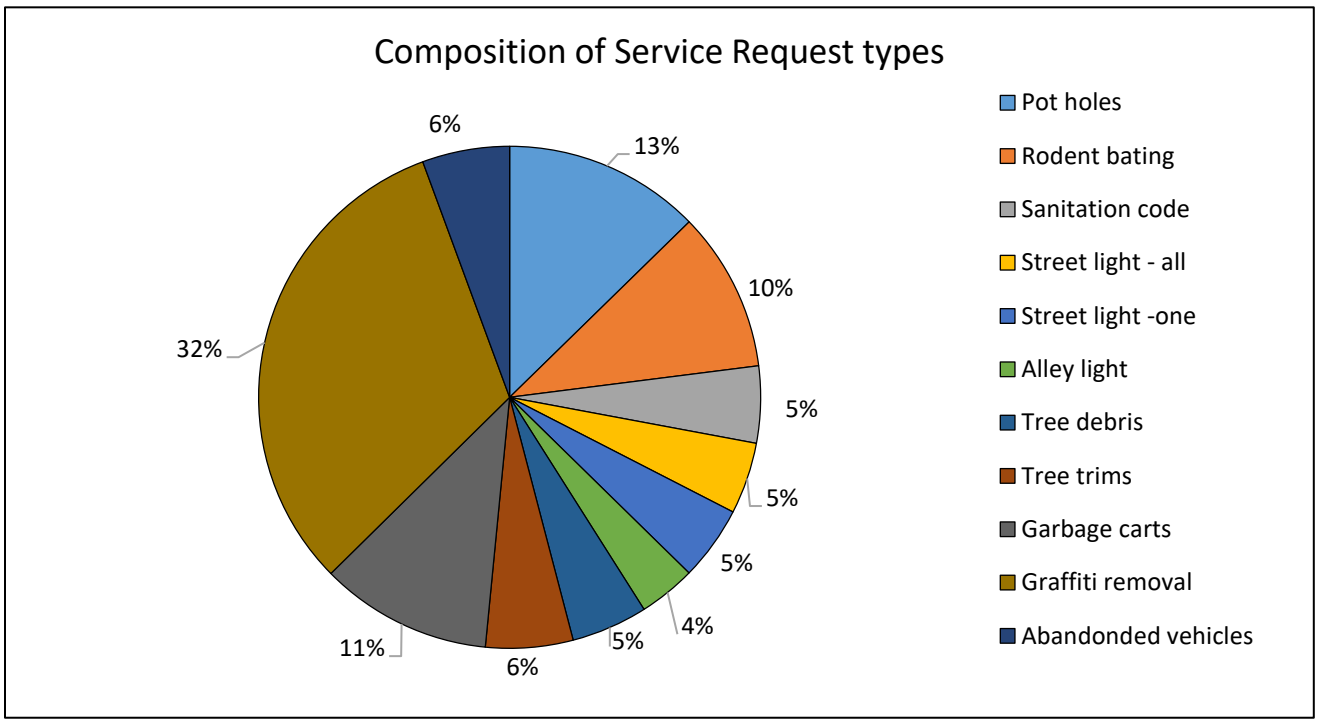
## Appendices

### Appendix A - Completed Service Requests from 2012 to 2018, Graffiti Removal

| Ward | Completed SRs | Graffiti Removal | SR minus Graffiti | Graffiti as % of total SRs |
|---|---|---|---|---|
| **1** | 85,867 | 50,306 | 35,561 | 59% |
| **2** | 46,772 | 15,888 | 30,884 | 34% |
| **3** | 28,847 | 4,472 | 24,375 | 16% |
| **4** | 23,001 | 3,287 | 19,714 | 14% |
| **5** | 26,093 | 2,066 | 24,027 | 8% |
| **6** | 47,426 | 1,122 | 46,304 | 2% |
| **7** | 36,564 | 1,912 | 34,652 | 5% |
| **8** | 48,253 | 1,330 | 46,923 | 3% |
| **9** | 44,842 | 1,853 | 42,989 | 4% |
| **10** | 49,952 | 13,289 | 36,663 | 27% |
| **11** | 70,948 | 31,380 | 39,568 | 44% |
| **12** | 78,816 | 50,271 | 28,545 | 64% |
| **13** | 63,553 | 14,084 | 49,469 | 22% |
| **14** | 97,846 | 60,058 | 37,788 | 61% |
| **15** | 48,110 | 15,847 | 32,263 | 33% |
| **16** | 48,573 | 14,559 | 34,014 | 30% |
| **17** | 46,352 | 3,771 | 42,581 | 8% |

| | | | | |
|---|---|---|---|---|
| **18** | 60,782 | 9,136 | 51,646 | 15% |
| **19** | 53,412 | 1,770 | 51,642 | 3% |
| **20** | 34,599 | 5,584 | 29,015 | 16% |
| **21** | 51,251 | 1,464 | 49,787 | 3% |
| **22** | 52,990 | 27,984 | 25,006 | 53% |
| **23** | 71,883 | 28,628 | 43,255 | 40% |
| **24** | 43,838 | 7,573 | 36,265 | 17% |
| **25** | 71,617 | 45,089 | 26,528 | 63% |
| **26** | 53,848 | 21,492 | 32,356 | 40% |
| **27** | 59,731 | 21,554 | 38,177 | 36% |
| **28** | 54,795 | 11,369 | 43,426 | 21% |
| **29** | 39,911 | 5,906 | 34,005 | 15% |
| **30** | 56,511 | 24,126 | 32,385 | 43% |
| **31** | 55,877 | 24,897 | 30,980 | 45% |
| **32** | 73,999 | 29,009 | 44,990 | 39% |
| **33** | 63,505 | 34,206 | 29,299 | 54% |
| **34** | 52,984 | 1,210 | 51,774 | 2% |
| **35** | 70,439 | 36,086 | 34,353 | 51% |
| **36** | 49,837 | 9,902 | 39,935 | 20% |
| **37** | 45,425 | 6,196 | 39,229 | 14% |
| **38** | 54,390 | 11,343 | 43,047 | 21% |
| **39** | 53,210 | 13,424 | 39,786 | 25% |
| **40** | 47,749 | 16,576 | 31,173 | 35% |
| **41** | 43,050 | 1,780 | 41,270 | 4% |
| **42** | 41,672 | 19,307 | 22,365 | 46% |
| **43** | 39,271 | 13,692 | 25,579 | 35% |
| **44** | 38,196 | 15,901 | 22,295 | 42% |
| **45** | 59,385 | 12,981 | 46,404 | 22% |
| **46** | 22,277 | 9,459 | 12,818 | 42% |
| **47** | 70,195 | 37,399 | 32,796 | 53% |
| **48** | 25,429 | 9,303 | 16,126 | 37% |
| **49** | 30,250 | 9,561 | 20,689 | 32% |
| **50** | 51,858 | 11,916 | 39,942 | 23% |

## Appendix B - Composition and Amount of Service Request Types (2012-2018, Completed)




## Appendix B - Volume of 311 SRs by Request Type

| 2018-2018 | SR Total | Average |
|---|---|---|
| Pot holes | 327,964 | 6,559 |
| Rodent bating | 266,599 | 5,332 |
| Sanitation code | 127,895 | 2,558 |
| Street light - all | 119,255 | 2,385 |
| Street light -one | 123,711 | 2,474 |
| Alley light | 95,075 | 1,902 |
| Tree debris | 127,142 | 2,543 |
| Tree trims | 145,412 | 2,908 |
| Garbage carts | 286,198 | 5,724 |
| Graffiti removal | 821,318 | 16,426 |
| Abandoned vehicles | 145,412 | 2,908 |
| **Citywide SRs (All types)** | **2,585,981** | **51,720** |

## Appendix C - Maps

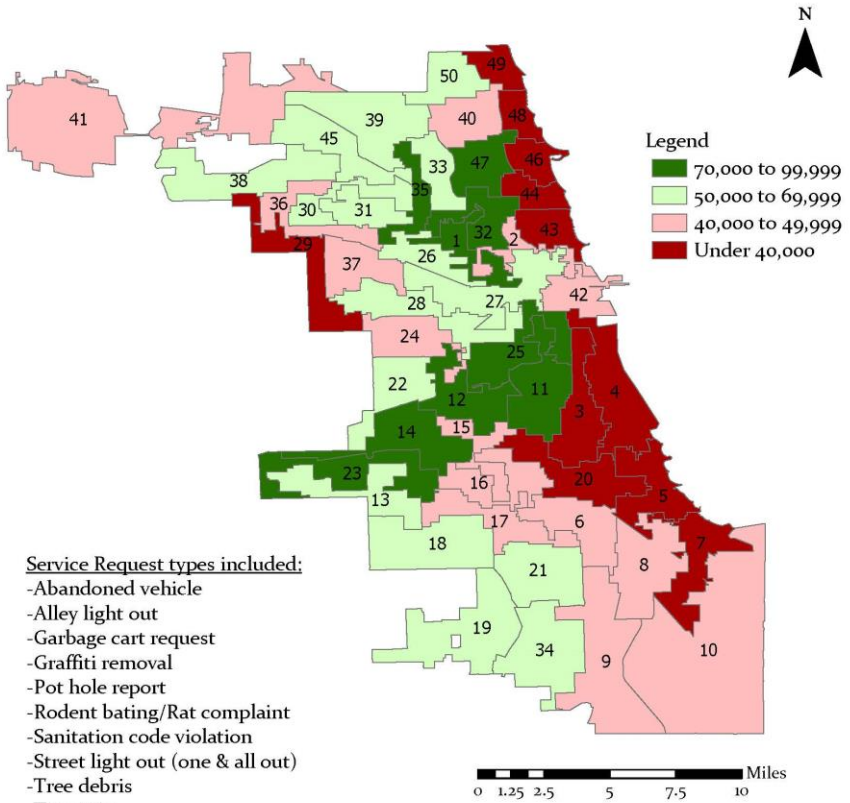
a. **Completed Service Requests from 2012 to 2018 in Chicago Wards**

b. **Completed Service Requests from 2012 to 2018 in Chicago Wards – Graffiti Removal not included**

c. **Wards in which at least 50% of Completed Service Requests from 2012 to 2018 were Graffiti Removal**

d. **Wards with the Most and Least Service Request Completion – Graffiti Removal not included**

## Completed 311 Service Requests from 2012 to 2018 in Chicago Wards

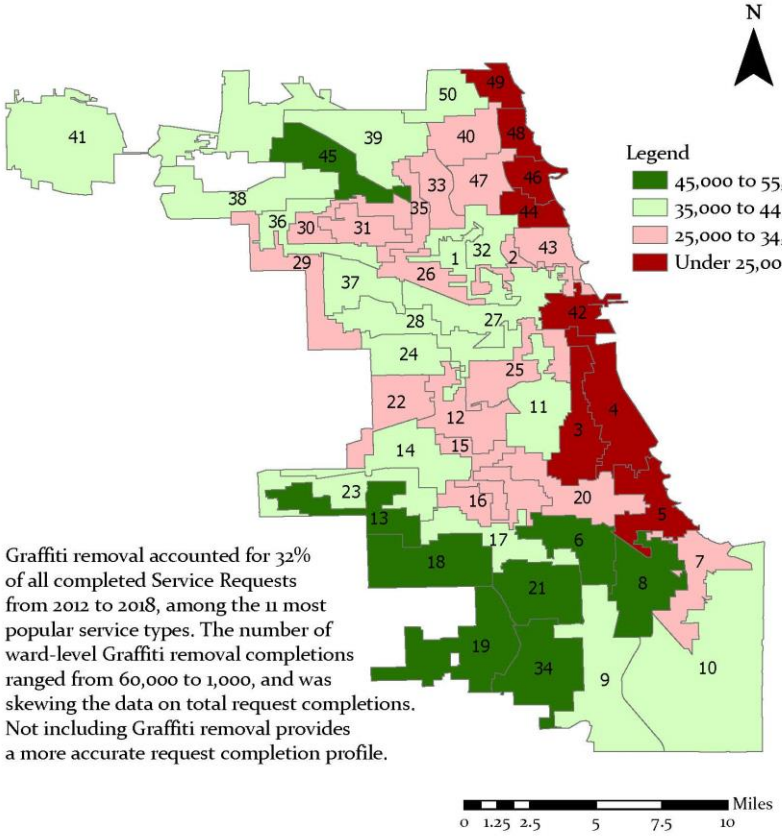



Service Request types included:
-Abandoned vehicle
-Alley light out
-Garbage cart request
-Graffiti removal
-Pot hole report
-Rodent bating/Rat complaint
-Sanitation code violation
-Street light out (one & all out)
-Tree debris
-Tree trim

Map created by Matt D'Onofrio
DePaul University Honors Program
Spring 2019 Senior Thesis

Source: Chicago Open Data Portal

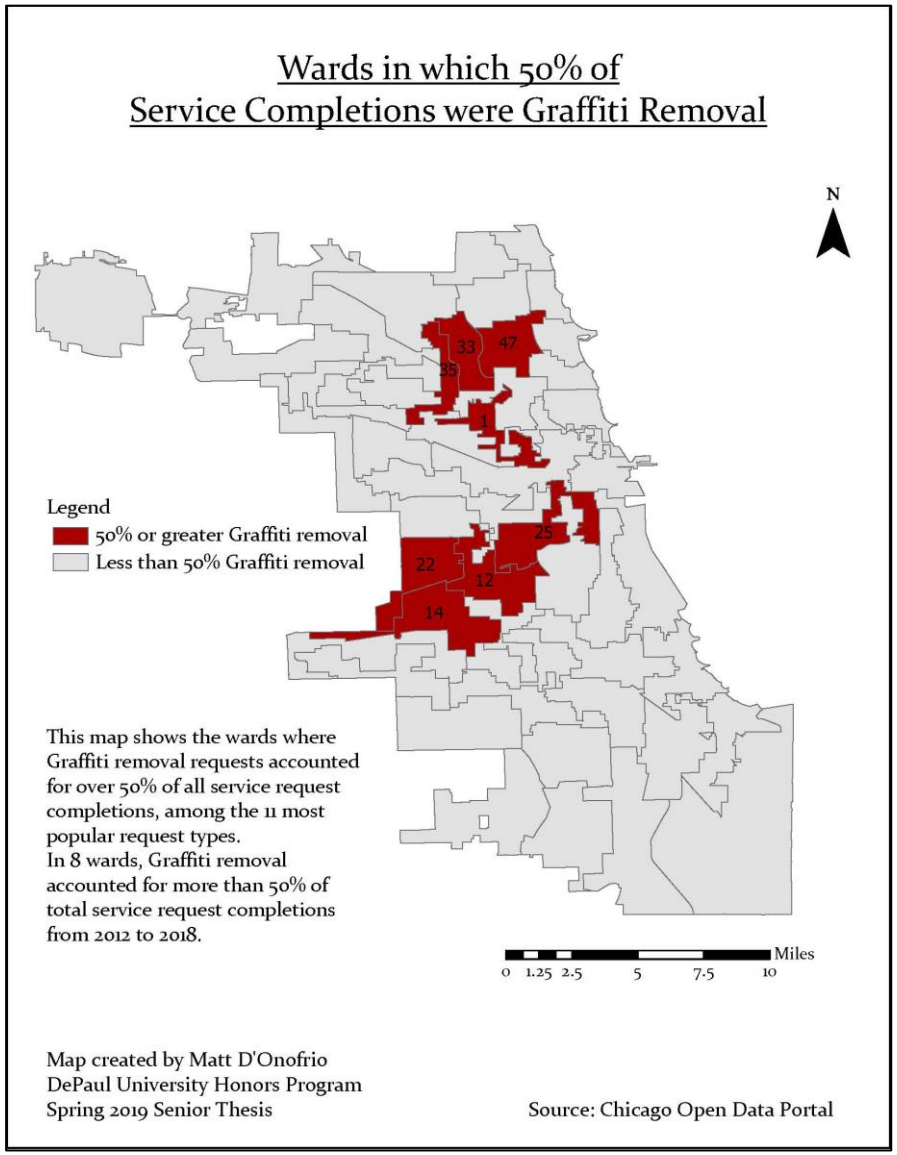
## Completed 311 Service Requests from 2012 to 2018 - Graffiti not included

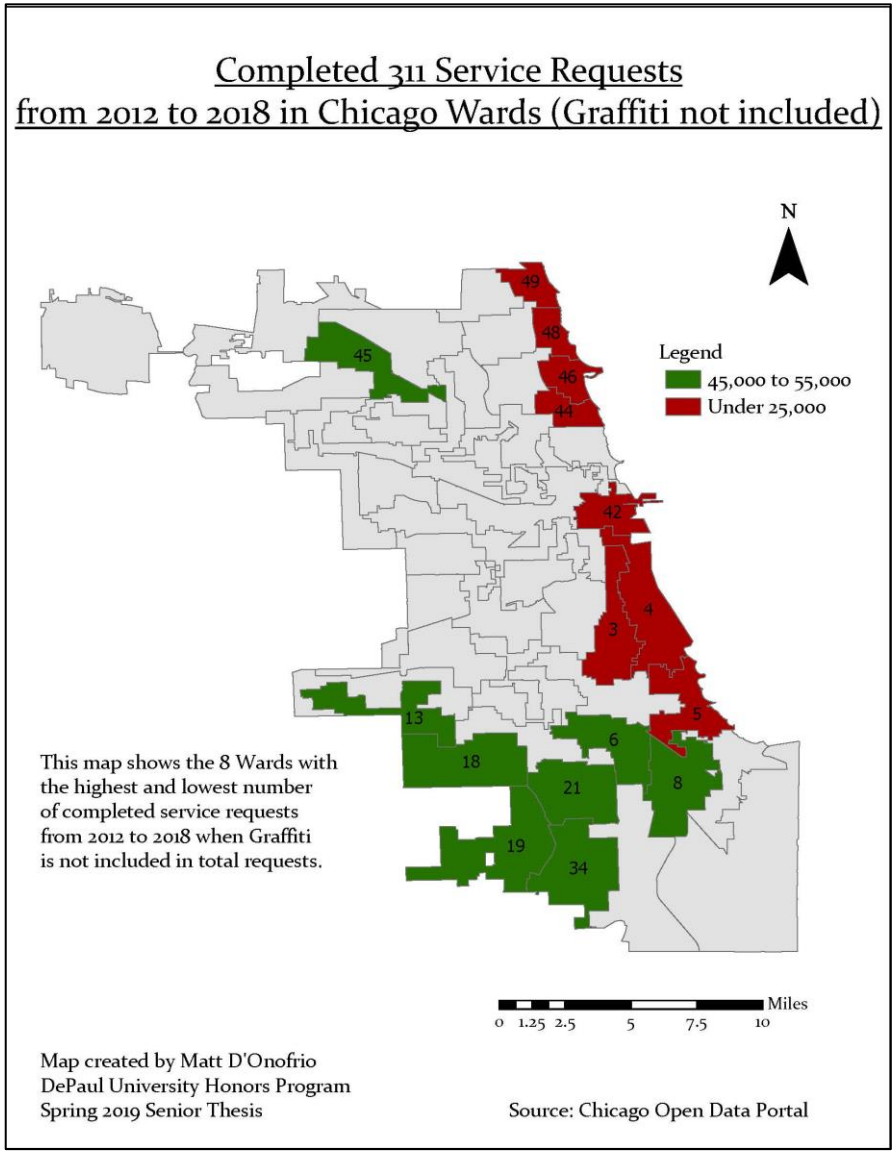



Graffiti removal accounted for 32% of all completed Service Requests from 2012 to 2018, among the 11 most popular service types. The number of ward-level Graffiti removal completions ranged from 60,000 to 1,000, and was skewing the data on total request completions. Not including Graffiti removal provides a more accurate request completion profile.

Map created by Matt D'Onofrio
DePaul University Honors Program
Spring 2019 Senior Thesis

Source: Chicago Open Data Portal


Wards in which 50% of
Service Completions were Graffiti Removal
N
33
47
35
1
25
22
12
14
Legend
50% or greater Graffiti removal
Less than 50% Graffiti removal
This map shows the wards where Graffiti removal requests accounted for over 50% of all service request completions, among the 11 most popular request types.
In 8 wards, Graffiti removal accounted for more than 50% of total service request completions from 2012 to 2018.
Miles
0 1.25 2.5 5 7.5 10
Map created by Matt D'Onofrio
DePaul University Honors Program
Spring 2019 Senior Thesis
Source: Chicago Open Data Portal


Completed 311 Service Requests
from 2012 to 2018 in Chicago Wards (Graffiti not included)
N
49
48
45
46
44
42
4
3
5
13
6
18
21
8
19
34
Legend
45,000 to 55,000
Under 25,000
This map shows the 8 Wards with the highest and lowest number of completed service requests from 2012 to 2018 when Graffiti is not included in total requests.
Miles
0 1.25 2.5 5 7.5 10
Map created by Matt D'Onofrio
DePaul University Honors Program
Spring 2019 Senior Thesis
Source: Chicago Open Data Portal

## Appendix D - Crosstabulations

### a. Crosstab of All service request types by independent variables

**Statistically significant POSITIVE relationships**

| Completed service requests by percent Hispanic/Latino population (2010) | | Hispanic/Latino Population (2010) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 18 (72%) | 7 (28%) |
| | Above Average | 7 (28%) | 18 (72%) |

| Completed service requests by Active business licenses (2019) | | Active Business Licenses (2019) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 16 (64%) | 9 (36%) |
| | Above Average | 9 (36%) | 16 (64%) |

| Completed service requests by Estimated population change (2010 to 2016) | | Estimated population change | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 16 (64%) | 9 (36%) |
| | Above Average | 9 (36%) | 16 (64%) |

| Completed service requests by Estimated 2016 Population | | Estimated 2016 Population | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 14 (56%) | 11 (44%) |
| | Above Average | 11 (44%) | 14 (56%) |

| Completed service requests by percent White population (2010) | | White Population (2010) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 14 (56%) | 11 (44%) |
| | Above Average | 11 (44%) | 14 (56%) |

| Completed service requests by percent of Single Family homes (2017) | | % Single Family Homes | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 14 (56%) | 11 (44%) |
| | Above Average | 11 (44%) | 14 (56%) |

| Completed service requests by percent of 2 to 4 Unit Buildings (2017) | | % 2 to 4 Unit Buildings (2017) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 14 (56%) | 11 (44%) |
| | Above Average | 11 (44%) | 14 (56%) |

**Statistically significant NEGATIVE relationships**

| Completed service requests by percent Black population (2010) | | Black Population (2010) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 7 (28%) | 18 (72%) |
| | Above Average | 18 (72%) | 7 (28%) |

| Completed service requests by Arrests (2018) | | Arrests (2018) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 7 (28%) | 18 (72%) |
| | Above Average | 18 (72%) | 7 (28%) |

| Completed service requests by Total crimes reported (2018) | | Total crimes reported (2018) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 7 (28%) | 18 (72%) |
| | Above Average | 18 (72%) | 7 (28%) |

| Completed service requests by percent of 5+ Unit Buildings (2017) | | % 5+ Unit Buildings (2017) | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 8 (32%) | 17 (68%) |
| | Above Average | 17 (68%) | 8 (32%) |

| Completed service requests by 2015 Voter registration | | 2015 Voter Registration | |
|---|---|---|---|
| | | Below Average | Above Average |
| Service Requests | Below Average | 10 (40%) | 15 (60%) |
| | Above Average | 15 (60%) | 10 (40%) |

### b. Crosstab of Service request types <u>without Graffiti removal</u>

**Statistically significant POSITIVE relationships**

| Completed service requests by Single Family Homes (2017) | | Single Family Homes | |
|---|---|---|---|
| | | Below Average | Above Average |
| **Service Requests** | Below Average | 19 (76%) | 6 (24%) |
| | Above Average | 6 (24%) | 19 (76%) |

| Completed service requests by Voter Registration & Turnout in 2015 Municipal Election | | Registered Voters & Turnout in 2015 | |
|---|---|---|---|
| | | Below Average | Above Average |
| **Service Requests** | Below Average | 14 (56%) | 11 (44%) |
| | Above Average | 11 (44%) | 14 (56%) |

**Statistically significant NEGATIVE relationships**

| Completed service requests by 5+ unit buildings (2017) | | 5+ Unit Buildings | |
|---|---|---|---|
| | | Below Average | Above Average |
| **Service Requests** | Below Average | 8 (32%) | 17 (68%) |
| | Above Average | 17 (68%) | 8 (32%) |

| Completed service requests by Asian population (2010) | | Asian Population | |
|---|---|---|---|
| | | Below Average | Above Average |
| **Service Requests** | Below Average | 9 (36%) | 16 (64%) |
| | Above Average | 16 (64%) | 9 (36%) |

| Completed service requests by Condominiums (2017) | | Condominiums | |
|---|---|---|---|
| | | Below Average | Above Average |
| **Service Requests** | Below Average | 10 (40%) | 15 (60%) |
| | Above Average | 15 (60%) | 10 (40%) |

| Completed service requests by Active Business Licenses (2019) | | Business Licenses | |
|---|---|---|---|
| | | Below Average | Above Average |
| **Service Requests** | Below Average | 10 (40%) | 15 (60%) |
| | Above Average | 15 (60%) | 10 (40%) |

## <u>Appendix E - Variable Definitions</u>

- Dependent variable – Service requests (SRs) completed from 2012 to 2018 (See Appendix A for SR types)

    - Includes 11 service request types which are available on the Chicago Data Portal, and include the 'ward' datapoint
    - Data was filtered by '2012 to 2018' and by 'Completed'
- Control Variable – 2010 Population as measured by the US Census
- Independent Variables
    - Population change from 2010 to 2012-2016 (2 data points)
    - Housing composition (2017): Single family; 2 to 4 unit; 5+ unit; and, condominiums (4 data points)
    - Racial demographics (2010): White; Black; Hispanic/Latino; Asian; and, Other (5 data points)
    - Crimes reported & arrests made (2018) (4 data points – Difference between crimes reported and arrests, and, arrests as a percent of total crimes were also tested and deemed duplicative)
    - 2015 & 2019 Municipal General Election: Voter registration and turnout (6 data points – Aldermanic tenure, and difference between 2015 turnout vs. 2019 turnout were also tested and deemed non-functional)
    - Currently active business licenses (2019, April) (1 data point)