**“Analyzing NYC 311 Service Requests: Identifying Patterns, Prioritizing Issues, and Improving Public Services”**

A Literature Review

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**Abstract**

*Since it started in March 2003, the New York City (NYC) 311 call line (and more recently its website and app) has let people ask for help with non-emergency government services. People in New York can call 311 to ask for information or to let the government know about a problem that needs fixing. Every time someone calls 311 for help, the request is sorted into one of 278 different types of complaints, this helps the city know what kinds of issues people need help with. These NYC311 data is updated daily and contains information about more than 24 million service requests made since 2010. There are different departments to solve the different requests, although these complaints are not necessarily urgent, the large volume of complaints and the sudden increase impact the agency's overall efficiency. This paper discusses my process for exploring trends in a recent subset of the data (March-Oct. 2023), and for building a Machine learning and deep learning model which will help Agencies improve service delivery by allowing them to focus on their core missions and manage their workload efficiently.*

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**Introduction**

City officials and urban planners believe that technology can help people connect with their government better. One example of this is NYC311, a technology that started in 2003. It allows people to reach out to their government, get information, and request services 24/7. It uses things like customer management software, smartphones, and apps to make it easier for citizens to communicate with the government. It's like a one-stop-shop where people can contact any government agency using one platform or one phone number. This new way of talking to the government raises questions about how it affects the services provided by the government and what the data gathered from these interactions can tell us about how people participate in civic life [4].

NYC311 is mostly used to make government services more efficient and to make sure people have access to the information they need. It's part of a shift toward e-governance that started in the 1990s. This strategy helps local governments work better by using technology from the private sector. The service not only helps city agencies but also provides data that shows what a community needs. This data is made available to the public as part of the NYC Open Data Initiative. Looking at this data makes us think about how the needs expressed through this technology are different or similar to those expressed in other ways.

A diagram of a system

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**Figure 1**

The Figure 1 [5] illustrate the process, demonstrating that a 311 request is often a singular interaction with the service, centered around a local issue relevant to an individual. While it can be argued that a problem affecting one person may have wider implications, it typically arises in response to something specific in an individual's environment, making it a personal concern rather than a communal one. However, if numerous individuals report the same issue, it signifies a broader impact and may prompt prioritization by the responding agency.

While a pothole might be an obvious problem to report, issues like a damaged sidewalk or a broken bike stand may receive less attention, and some individuals may not be aware that they can report them. There's a perception that these specific issues are within the purview of government agencies to resolve. Residents who understand the range of services their local agencies offer are more likely to use the service to request assistance. Expectations of service can vary based on an individual's past experiences with public services and their local government agencies. This perception influences who submits requests. The desire to receive a necessary service at a particular moment drives the request.

The act of submitting a request is a swift process, whether done through a mobile device, phone, or computer. It may be a one-time occurrence, a reaction to a situation rather than a proactive effort to address broader community needs with stakeholders. It typically requires interaction with a phone operator, though even this can be bypassed by using alternative channels. This streamlined communication pathway accelerates the process of gathering resident feedback and handling requests.

The data collected from this service can be used in various ways. Agencies use it to provide services and information to the public [8]. But they can also use it to gain new insights and maybe even predict where problems might come up. How useful this data is depending on how agencies think about it. This raises questions like: what are the most complaints that are registered? How do the number of requests fit into the bigger plans of the government agencies? How to priorities requests? By examining how this data connects to bigger decision-making processes, we can understand its value better.

To investigate these questions, this research delves into how the extensive data provided by citizens influences the operations and overarching strategies of city agencies. To extract valuable insights from this vast dataset, we employ advanced analytical techniques. Additionally, we harness the power of machine learning and deep learning models to make predictions. These predictive models aid agencies in enhancing service delivery by enabling them to concentrate on their primary objectives and manage their workloads efficiently [6].

**Background**

The very first 311 service started in 1996 in Baltimore, with help from a federal grant. It was created to handle all the non-emergency calls that were clogging up the 911 system. The success of this trial run was obvious right away, and the 311 number was reserved nationally for police departments to redirect such calls. Since then, this service has been introduced in all the major cities in the United States, and it has grown to include more ways for people to connect with it. The expansion was driven partly by the popularity of social networking sites and the need to save money on call center staff. This service is now a vital part of city technology and is woven into the framework of city governance [3].

NYC311 was launched in New York City on March 11, 2003, during Mayor Michael Bloomberg's time in office. The goal was to make the government work more efficiently, and Bloomberg used data and technology to bring about this change. NYC311 was the first technology project of his administration. It involved consolidating more than 40 call centers from various city agencies, which was quite a challenging task. However, it turned out to be a success. The positive outcomes of this customer management service led to its adoption in over 300 cities across the United States. While the main focus was on improving processes and accountability, the service also provided a way for citizens to have their voices heard and represented [5]. It became a vital communication bridge and a fundamental part of city services.

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**Figure 2**

The 311 categories examined by Scott Minkoff [6] and his analysis account for 37% of the service requests made from the residential areas studied between 2007 and 2012. These categories also represent 31% of all 311 service requests during the same time frame. Despite the overall increase in 311 service requests throughout New York City (as reported by the City of New York in 2014), the data from the city indicate a consistent annual decrease in these specific categories at the neighborhood level, as shown in Figure 1.

The data generated by this service was made available to the public and is used for various purposes, from citizen advocacy to academic research. During emergencies and disasters, it has played a crucial role in helping agencies allocate resources where they are most needed. This paper explores the value this service brings to both agencies and citizens and how these requests can be solved more efficiently.

**Literature Review**

The NYC311 service has been a cornerstone of civic engagement and efficient service delivery since its inception in 2003. Over the years, it has evolved to meet the ever-changing needs of city residents and agencies. This literature review seeks to contextualize a research project focused on exploring trends within a recent subset of NYC311 data (March-Oct. 2023) and developing advanced Machine Learning (ML) and Deep Learning (DL) models to enhance service delivery efficiency.

311 services have significantly evolved since their introduction, becoming integral components of urban governance. This transformation is marked by a shift from traditional telephone-based systems to web portals and mobile applications. These advancements have facilitated access to information and services for city residents and have allowed for real-time interactions with local government agencies (Bryne et al., 2017). The NYC311 research project represents a significant step in understanding and leveraging this evolution for improved service delivery.

***The Role of Data in Civic Engagement***

Data generated by the NYC311 service has emerged as a valuable asset for civic engagement and participatory governance. As cities become increasingly data-driven, there is a growing emphasis on making this data accessible and transparent to the public. NYC's Open Data Initiative, which makes the 311 datasets publicly available, serves as a prominent example of this trend (Caragliu et al., 2011). Analyzing recent data trends in the NYC311 project aligns with the broader commitment to open data and civic participation.

The digital transformation in governance sought to modernize and improve how governments operate by leveraging cutting-edge digital technologies. While many governmental processes have transitioned to digital platforms, their actual impacts and outcomes are subjects of ongoing research and evaluation. In this context, the adoption of customer relationship management (CRM) tools has gained prominence across cities in the United States due to their ability to enhance service delivery (Layne and Lee, 2001).

Traditionally, CRM tools were categorized separately from civic technologies and engagement tools. However, this categorization is evolving. There is a growing recognition that CRM tools, often associated with the private sector, now play a crucial role in the realm of civic technologies and tools for public engagement. This shift in conceptualization underscores the dynamic nature of technology's influence on government operations and its potential to improve citizen-government interactions and overall service quality.

***Predictive Analytics and Machine Learning in Public Services***

The application of machine learning and deep learning models to public service delivery is a burgeoning field. Predictive analytics, in particular, has the potential to revolutionize how city agencies respond to service requests. By analyzing historical data, agencies can predict service demands and allocate resources more efficiently. These models also enable agencies to prioritize requests based on their potential impact and urgency (Ben-Nun et al., 2018). Integrating these advanced technologies into the NYC311 project aims to improve service delivery in a dynamic and data-driven manner.

The potential of 311 data extends beyond its immediate application for service requests. Research conducted at NYU's Center for Urban Science and Progress (CUSP) has demonstrated its effectiveness in predictive modeling. Specifically, it has been employed to develop models capable of proactively identifying issues like building safety hazards, rather than merely reacting to them after they occur. Moreover, these modeling efforts have unveiled significant disparities in reporting based on demographic factors such as race, gender, income, and educational attainment (Kontokosta et al., 2017).

Additionally, studies have shown that 311 data can be harnessed to model various socio-economic features. This information becomes a valuable resource for local stakeholders, enabling them to predict socio-economic performance and assess the outcomes of interventions (Wang et al., 2017). This capability proves particularly beneficial in disaster response efforts. Through appropriate modeling, cities can utilize insights derived from 311 data to enhance their resilience in the face of disasters (Zobel, Baghersad, and Zhang, 2017). In essence, this data serves as a reliable proxy for neighborhood conditions, offering immense value to city agencies in their decision-making processes.

***Efficiency and Workload Management***

Efficiency in public service delivery is crucial for city agencies to meet their core missions. The ability to manage workloads effectively while maintaining service quality is a persistent challenge. Machine learning models can help in automating routine tasks, categorizing requests, and even identifying emerging trends or issues that may require proactive attention. By doing so, agencies can optimize their operations, streamline their processes, and enhance their responsiveness (Bui et al., 2015).

The NYC311 research project is situated within a broader context of urban governance, data-driven decision-making, and technological innovation. By exploring recent data trends and integrating machine learning and deep learning models, the project aims to make valuable contributions to the field of civic technology and service delivery. Leveraging the insights gained from the literature reviewed here, it is poised to address contemporary challenges in urban governance, providing a template for other cities seeking to improve efficiency and responsiveness in their public service delivery systems.

**Methodology**

***Data Collection***

The research methodology for the NYC311 research project involves the exploration of trends in a recent subset of the data, specifically spanning from March to October 2023. This data subset is retrieved from the NYC open Data website [1], which is maintained and updated daily by the City of New York.

***Data Preprocessing***

Before analysis, the raw data is subjected to preprocessing to ensure data quality and consistency. This includes data cleaning, handling missing values, and formatting the data to make it suitable for the subsequent analyses.

***Geospatial Analysis***

To analyze the data geographically, the research will utilize the Kepler.gl geospatial analysis tool. This software will allow for the mapping and visualization of service requests in different parts of the city. This geospatial analysis will provide insights into the geographic distribution of service requests, hotspots of activity, and potential disparities in service delivery across different areas.

***Machine Learning Analysis***

The research employs machine learning techniques, specifically logistic regression and linear regression, to identify patterns and relationships within the dataset. Logistic regression will be used for classification tasks, such as predicting the probability of a service request belonging to a specific category or agency, while linear regression will help in understanding how different variables influence response times and service outcomes.

***Deep Learning Analysis***

For natural language processing (NLP) and classification tasks, a deep learning approach using Keras Neural Network will be implemented. This will assist in classifying the government agency that responded to a given call. The NLP model will analyze the textual data in service requests to predict the appropriate agency responsible for addressing the issue. This predictive model will be trained and tested on a labeled dataset to ensure accurate classification.

***Evaluation and Validation***

The machine learning and deep learning models will be evaluated using appropriate metrics, such as accuracy, precision, recall, and F1-score, to measure their performance. Cross-validation techniques will be applied to assess the models' robustness and generalizability.

***Integration of Insights for Service Improvement***

The research findings will be synthesized and integrated to provide actionable insights for government agencies. By identifying trends, geographic disparities, and improving the accuracy of agency classification, the research aims to help agencies optimize service delivery. These insights will allow agencies to focus on their core missions, manage their workload efficiently, and address citizen requests more effectively.

***Reporting and Dissemination***

The research project's findings will be reported through comprehensive reports, visualizations, and presentations. The insights gained will be disseminated to relevant stakeholders, government agencies, and the public to contribute to informed decision-making and service enhancement.

**Analysis & Results**

Every day, an extensive dataset captures information about thousands of 311 calls in New York City, detailing their time, location, and content. Analyzing trends within this data enables government agencies to enhance their responsiveness to non-emergency requests from the community. This project utilizes public data on 311 calls and community districts in NYC to investigate the prevalence of different call types, variations in daily call volume across districts, and the allocation of calls to various government agencies.

**Key Findings:**

* “Illegal Parking” is the most frequent complaint type.

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* The Brooklyn is the most affected borough by this complaint type, and it has registered the highest volume of complaints among all the boroughs.

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* There is total 14 agencies to handle these calls, the New York Police Department (NYPD) responded to just over 50% of all 311 calls.
* Most of the calls were made in afternoon.

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* Calls to the NYPD, which include all complaints, peak at the earliest and latest hours of the day.
* Illegal parking and Noise-related complaints comprised the overwhelming majority of calls each month.

We build a model that can accurately predict the type of complaint based on the time of day and the city where the complaint was filed. The XGB classifier (accuracy ~ 72%) performs same as the Logistic regression classifier (accuracy ~ 72%). Another goal of this project is to build a linear model that can accurately predict total time taken to resolve a call based on Hour at which call is received at the Agency, given a set of observations of an independent variable Hour at which call is received and a dependent variable total time. The linear regression model has performed the best with root mean square error (RMSE) 0.25.

Finally, with all the findings and leveraging natural language processing and the Keras library, the project aims to construct a neural network capable of classifying the responding government agency based on the call's description.

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Accuracy and loss curves show that the model began to learn at a mostly steady rate after about 50 epochs. The best-performing model had ~92% accuracy on the test data and 67.2% accuracy on the random subset. It performed most successfully on calls assigned to the NYPD, HBD and DPR, although the agency variable exhibited substantial imbalance, with the NYPD responding to slightly over 50% of all 311 calls. The dataset encompassed 14 government agencies assigned to 311 calls, posing challenges in achieving perfect classifier accuracy. Currently, non-emergency service requests predominantly rely on phone calls; however, the development of such a classifier could streamline the automatic assignment of requests to the appropriate agency in an online context where requests generate text descriptions.

**Conclusion & Future Work**

Developing classification models to guide individuals to non-emergency government services and the appropriate responding agency presents an avenue for innovation. This application necessitates training on a broader set of descriptors to enhance its effectiveness. Future model evaluations should expand beyond accuracy metrics, encompassing a more comprehensive understanding of their performance. To better address call volume fluctuations, agencies should be mindful of temporal, geographic, and environmental factors. Anticipated changes, such as increased calls related to tree damage after severe weather or elevated noise complaints during late hours, should inform strategic planning. Consistent high call volumes in densely populated areas like Manhattan also warrant attention.

Considering that a significant portion of non-emergency requests falls under the jurisdiction of the same agency handling emergency requests, local stakeholders should assess the current division of labor in managing 311 calls. This evaluation becomes especially pertinent in light of concerns about the potential over-reliance on law enforcement for non-emergency interventions. Exploring optimal strategies for responding to diverse 311 requests aligns with the evolving needs and expectations of city residents, making it a worthwhile area for further investigation.

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