Manhattan in Motion: Visualizing Delivery Vehicle Crash Density for Safer Urban Mobility

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INTRODUCTION

- Manhattan, New York, serves as a bustling epicenter of commerce, experiencing a high volume of delivery truck activity daily. Efficient freight movement poses challenges related to traffic safety and congestion.
- Loading zones designated for delivery trucks serve as essential areas for quick drop-offs and pickups; however, some delivery vehicles may overstay their allocated time in loading zones, leading to congestion and reduced accessibility for other motorists and pedestrians. The high demand for rapid and efficient deliveries often leads delivery drivers to illegally double-park in busy urban streets [1].
- Fresh Direct, a prominent online grocery delivery service, operates an extensive system to fulfill customer orders between the hours of 7 am to 9 pm. The demand for timely deliveries, combined with limited available parking spaces, results in prolonged periods of double-parking throughout the day [2].
- The cumulative impact of delivery vehicles double-parking and occupying loading zones for extended periods can lead to reduced road capacity, traffic bottlenecks, and increased risk of accidents [3].

OBJECTIVES

- Shed light on the traffic volume and delivery truck crash density in Manhattan through mapping techniques.
- Explore the correlation between traffic volume densities, the occurrence of delivery truck crashes, and loading zones to understand the impact of congestion on road safety.
- Seek to identify critical areas prone to accidents, helping pave the way for effective safety measures and traffic management strategies.

METHODOLOGY

1. Data Collection and Cleaning
   - Obtain relevant datasets from authoritative sources.
   - Filter the datasets to include only records involving delivery vehicles during operation hours.
2. Data Integration and Visualization in ArcGIS
   - Import and layer each dataset as point coordinates in ArcGIS Pro.
3. Normalization for Crash Density Heat Map
   - Calculate the crash density by dividing each count of collisions by the nearest traffic volume count.
   - Utilize the normalized crash density data to create a heat map that visually represents areas with higher crash densities.
4. Identifying High Crash Density Areas and Contributors
   - Analyze the crash density heat map to locate clusters of high collision rates.
   - Assess contribution from delivery vehicle loading zones.

RESULTS

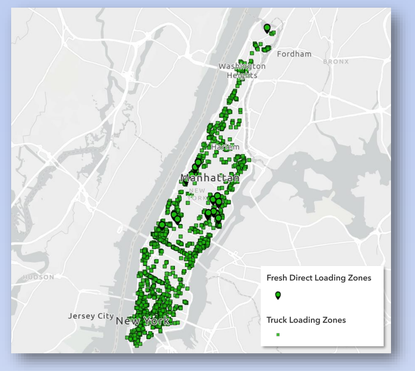

Figure 1. Delivery Vehicle and Fresh Direct Loading Zones

The map illustrates the distribution all delivery truck loading zones, including some Fresh Direct locations, in Manhattan.

Data Source: NYC Open Data

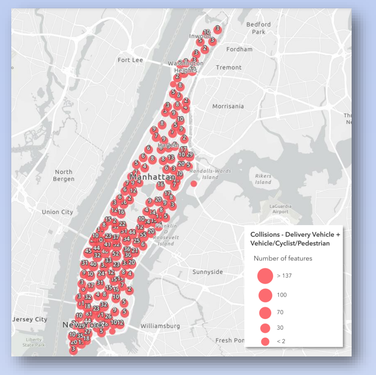

Figure 2. Delivery Vehicle Collisions

The map demonstrates the aggregated coordinates of delivery truck crash counts involving other motor vehicles, cyclists, or pedestrians resulting in injuries or fatalities from 2014 to 2023. These incidents encompass issues such as inattention/distraction, oversized vehicle, and view obstructed/limited.

Data Source: NYC Open Data

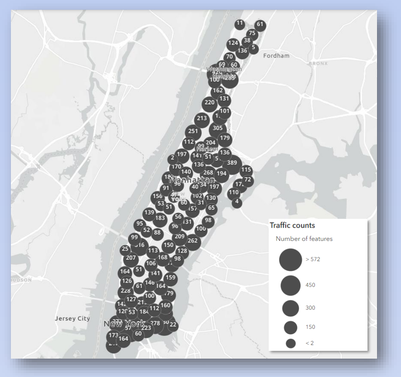

Figure 3. Traffic Volume Count

The map showcases the distribution and intensity of vehicular traffic volume counts across Manhattan.

Data Source: NYC DCAS

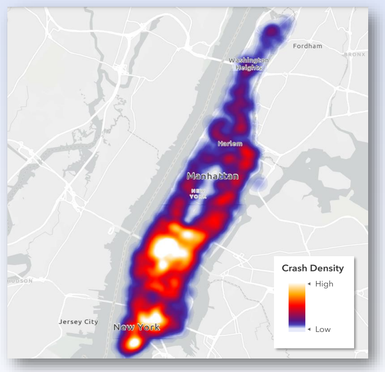

Figure 4. Normalized Collision Density

The generated heat map of Manhattan, derived from point coordinates of collision data, presents a comprehensive analysis of crash density in relation to traffic volume. Generalized hot spots, depicted in white, indicate areas with a high concentration of collisions, while cold spots shown in blue represent regions with comparatively lower crash density.

Data Source: NYC Open Data and NYC DCAS

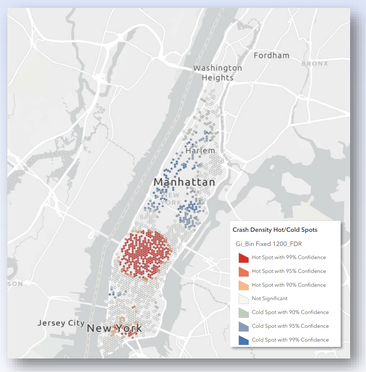

Figure 5. Collision Density Hot and Cold Spots

This map highlights the distribution of crash density, revealing areas with high concentrations of crashes and areas with relatively low crash occurrences.

Data Source: NYC Open Data and NYC DCAS

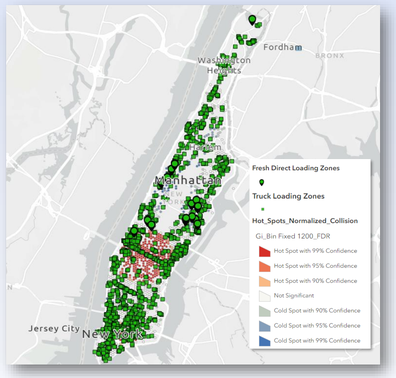

Figure 6. Integrated Map of All Delivery Vehicle Loading Zones and Collision Density Hot and Cold Spots

The comprehensive map overlays delivery vehicle and Fresh Direct loading zones onto areas of high-risk and low-risk crash density,

Data Source: NYC Open Data and NYC DCAS

DISCUSSION & CONCLUSION

- The map of loading zones indicates a higher concentration of trucks accompanying the southern region of Manhattan.
- The Fresh Direct loading zones were most frequently reported in the central area of Manhattan.
- Delivery vehicle collisions are most frequently concentrated in the southern region of Manhattan, with a significant number of crashes occurring deep within the borders of the city.
- The normalization process ensures an equitable portrayal of crash density in relation to traffic flow. Subsequent analysis uncovers two prominent hot spots of high crash density in the southern region of Manhattan.
- The traffic volume and crash data align with the patterns depicted in the normalized heat map, indicating a consistent correlation between higher traffic volume areas and regions of elevated crash density.
- While definitive evidence regarding the direct impact of Fresh Direct loading zones on collision rates remains elusive due to limited information, it is worth noting that all truck loading zones in the southern region of Manhattan align with areas of heightened crash density. This spatial correlation raises the possibility of loading zones playing a role in the observed collision patterns, underscoring the importance of conducting further investigations to comprehend their potential contribution to road safety challenges.

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CONTACT

For additional questions, you may contact me via LinkedIn.

Access to the map is available for reference.