MTA Turnstile Analysis: Extreme Weather

CREATED FOR: NYC Extreme Weather Task Force
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INTRODUCTION

OVERVIEW

- Climate change is increasing extreme weather patterns in NYC
- NYC Extreme Weather Task Force launched following the deadly impacts of Tropical Storm Ida in 2021 to improve citywide planning and response to extreme weather
- The Task Force needs transit data on storm system events to target MTA capital improvements and emergency planning strategies

PROJECT GOAL:

For 2021 hurricane season:

- Explore hurricane season ridership trends
- ID stations with highest impacts to service during and following storm events

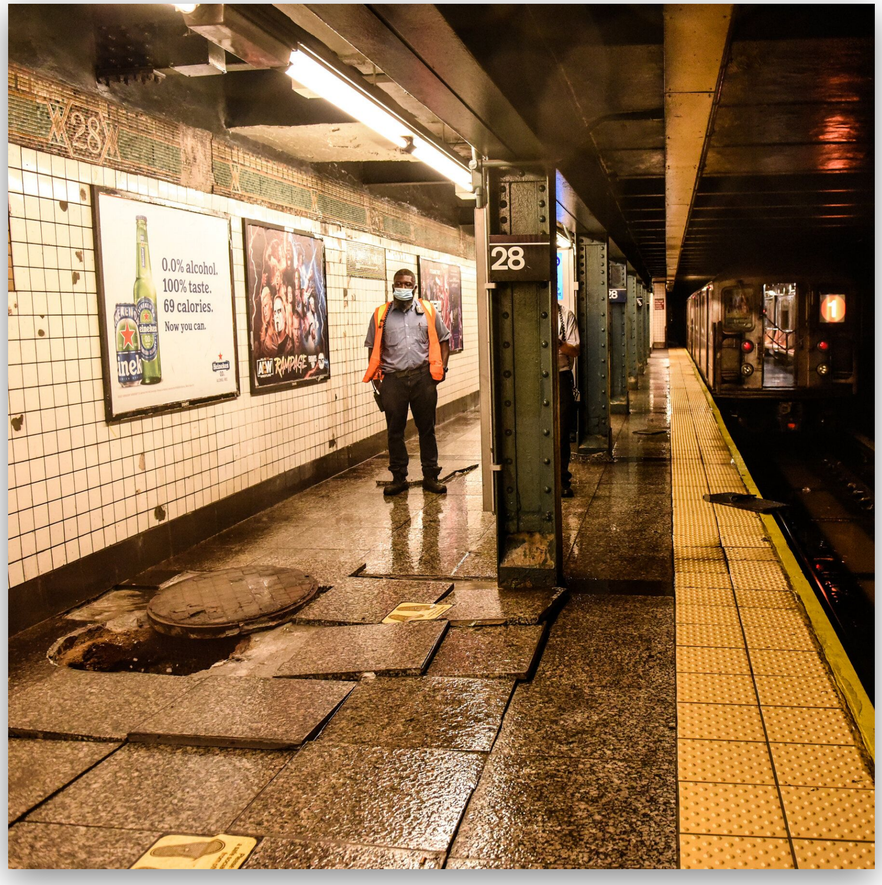
METHODOLOGY

DATA

- **MTA cumulative turnstile entry** data by station for peak storm season in New York (August 1 - October 31, 2021)
- **National Weather Service storm warning data** detailing dates and counties for official flash flood warnings

TOOLS

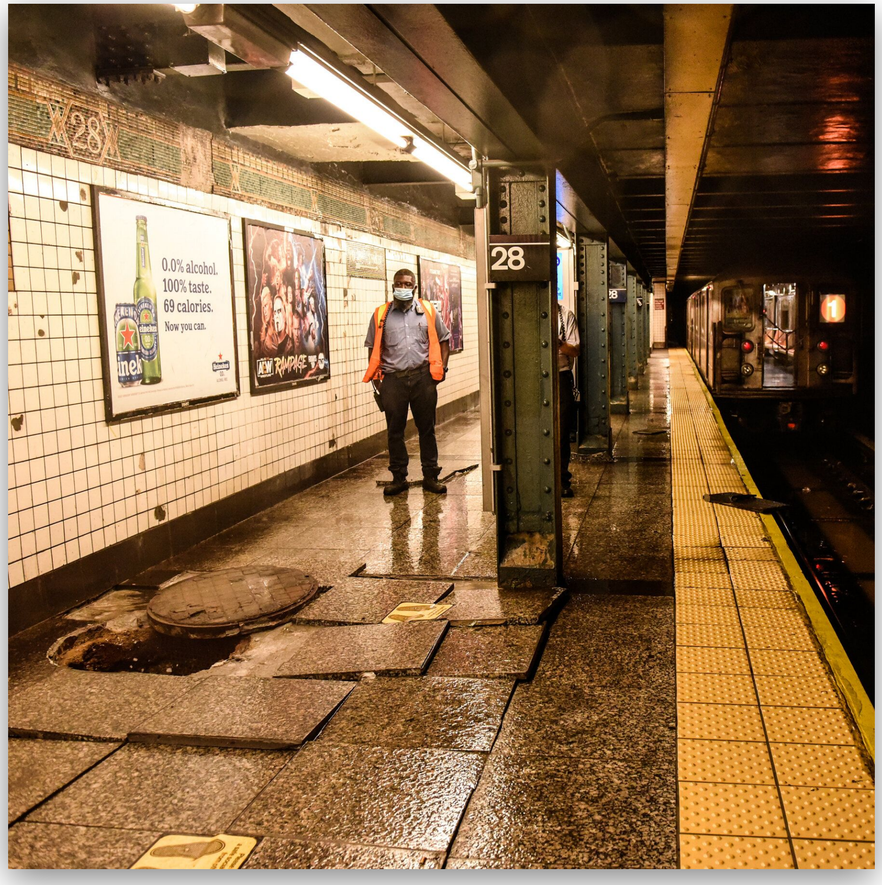
- SQLite and SQLAlchemy (data import)
- Pandas (data exploration / analysis)
- Matplotlib and Seaborn (data visualization)



METHODOLOGY

METRICS

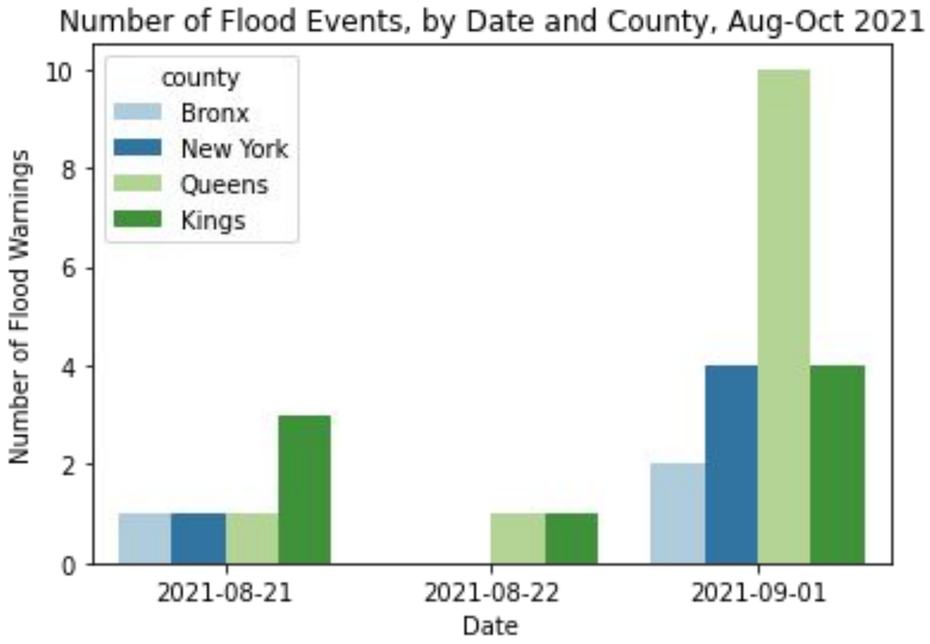
- Flood warning description data by county to **ID counties vulnerable to dangerous flash flood events**
- Merge the NWS and MTA data to **ID, aggregate, and compare storm weeks and non-storm weeks**
- Develop line plots to show **MTA entry trends by weekend (Su-Sa) and work week (M-F)** and **identify ridership trends during and after storm weeks**
- Drilling down on three weeks (before, during, and after storm Ida) to develop **% changes in ridership** comparing:
  - **before- and during-storm weeks (showing acute impact)**, and
  - **before- and after-storm weeks (showing more long-term impact)**

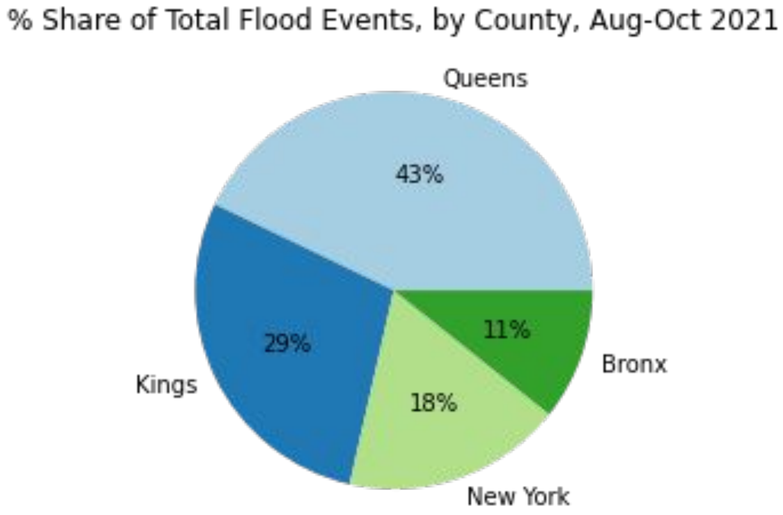


RESULTS

Flash Flood Warnings, by County

- During the study period, there were two storm events that caused flash flooding, (a) Aug 21-22 and (b) Sep 1 (Tropical Storm Ida)
- While the first storm had more sustained flooding, Ida had more severe flooding
- More than two-thirds of flood events (72%) were located in Queens and Kings.

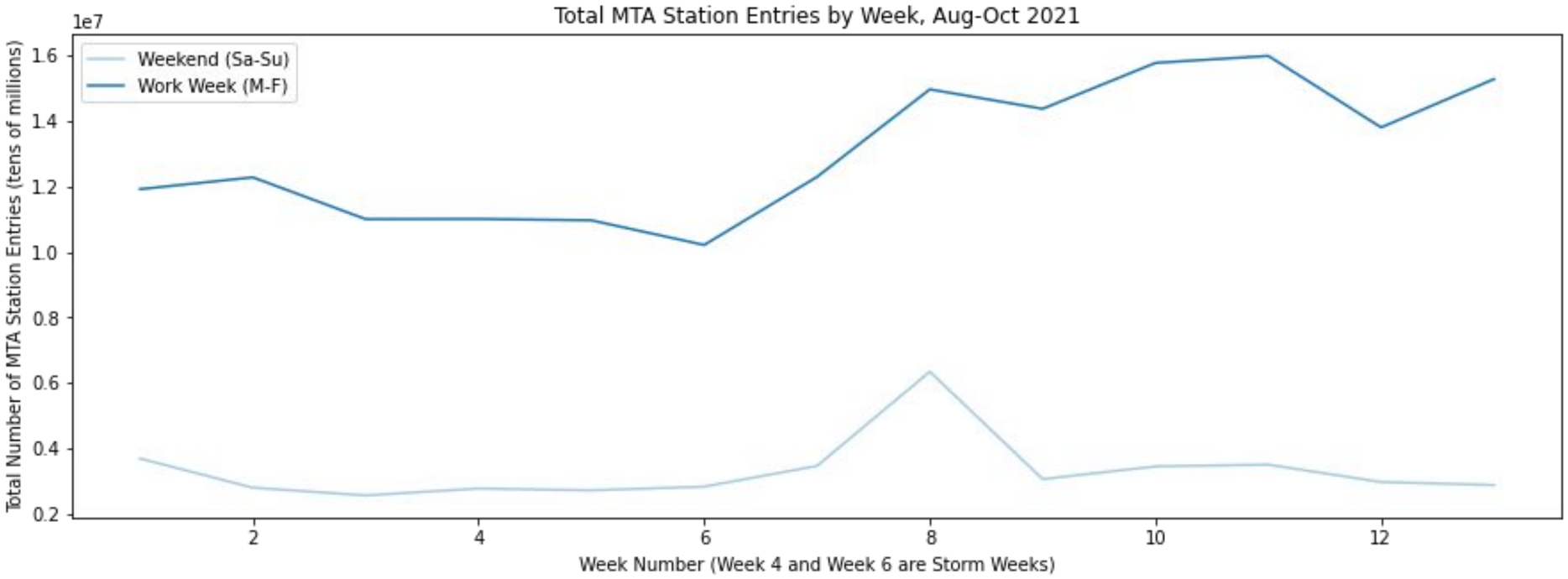




RESULTS

Weekly entry trends during hurricane season, categorized by weekend and work-week

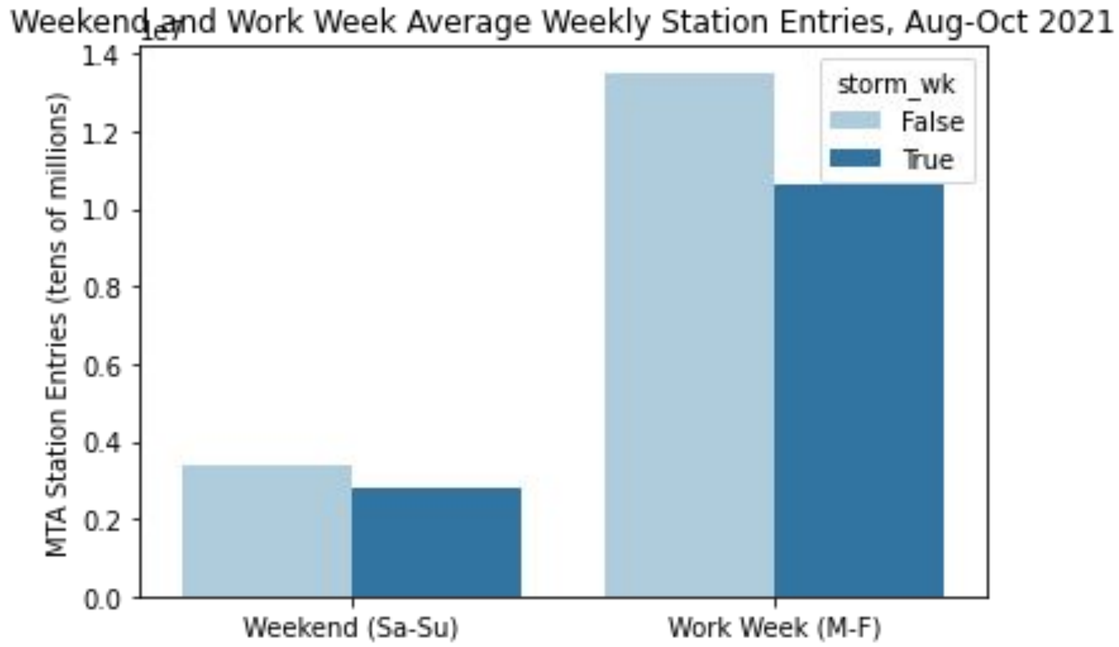
- Only storm Ida (wk 6) appears to have a drop in entries for the work week (Ida occurred on a Wednesday)
- Week 6 experienced a drop, followed by sustained increases over the following two weeks
- Weekend entries do not seem to be impacted by either storm
- Even though week 4's flooding occurred over a weekend, there does not appear to be any impact



RESULTS

Weekend and work-week station entry averages, categorized by storm week and non-storm week

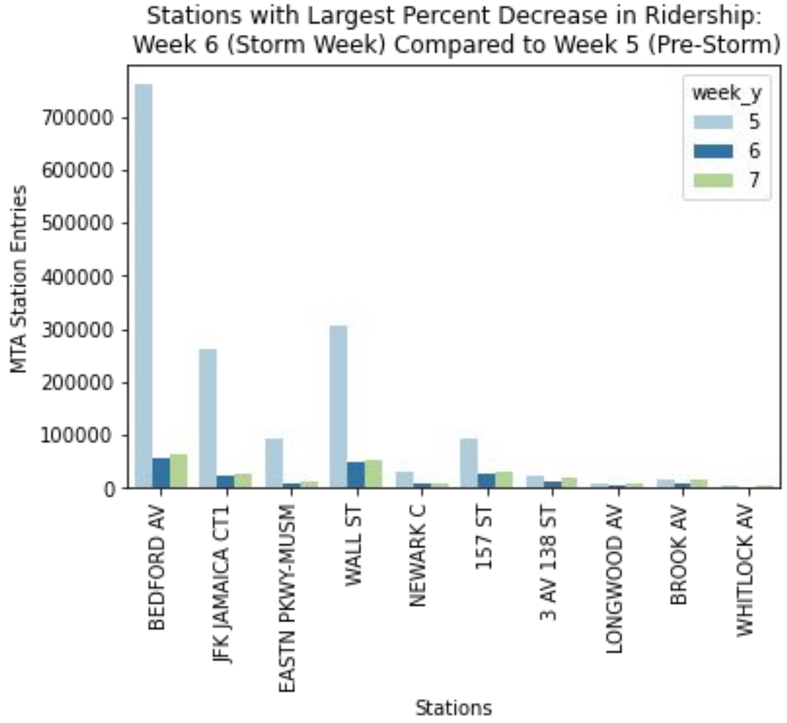
- Weekend average total MTA entries during non-storm weeks vs storm weeks is nearly the same
  - *Difference = 600,000 entries, well below the standard deviation of 1.04 million*
- The weekday average total MTA entries during non-storm weeks vs storm weeks appears to be significantly different
  - *Difference = 12.5 million entries, well above the standard deviation of 1.89 million*

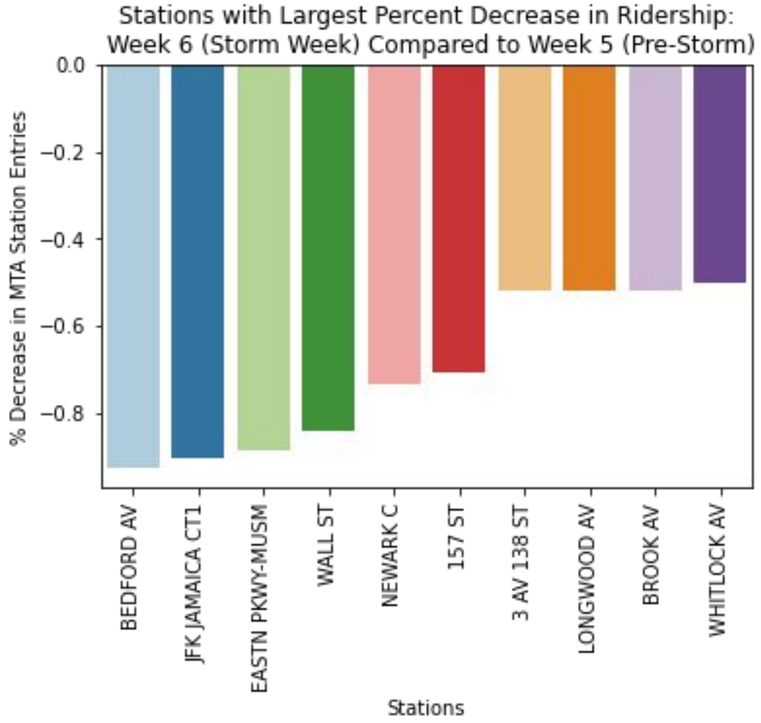


RESULTS

Stations with the largest % decrease in ridership from week 5 (pre-Ida) to week 6 (during-Ida)

- The top ten stations shown have 43-94% decreases in weekly ridership
- These stations show highest acute impacts to ridership

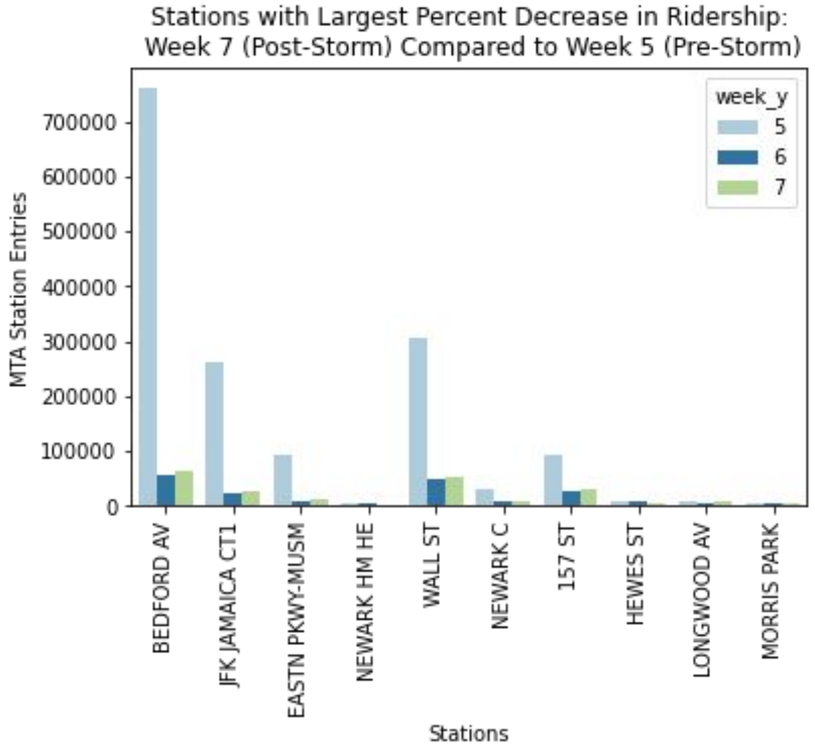


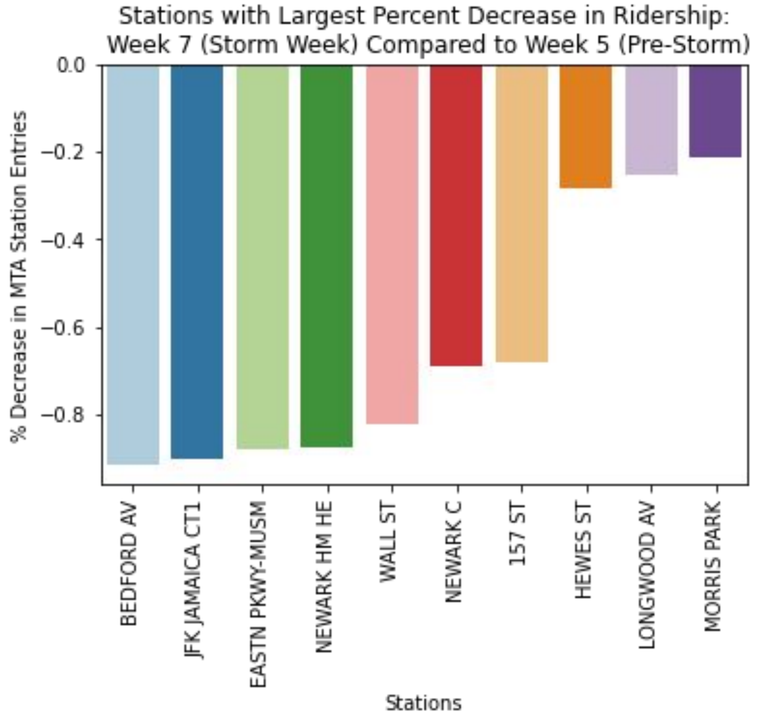


RESULTS

Stations with the largest % decrease in ridership from week 5 (pre-Ida) to week 7 (post-Ida)

- The top ten stations shown have 20-94% decreases in weekly ridership
- These stations show the highest long-term impacts to ridership, likely ID'ing stations with critical infrastructure damage
- 7/10 of these stations appear on both lists: Newark Hm, Bedford Av, Jfk Jamaica, Eastn Pkwy-Musm, Wall St, Newark, St-Penn Sta





CONCLUSIONS

- **Flooding is heaviest in Queens and Kings counties,** and these counties may generally be prioritized for flooding resilience capital improvements

- **Work weeks (vs weekends) tend to experience the highest level of impact to ridership,** possibly indicating needs for stations with heavy commuter flows to be prioritized for capital improvements

- **The 7 stations that experience the highest % decreases in ridership *during* Ida as well as *after* Ida should be researched as high priority candidates for capital improvement planning**