Final Project Progress Report

Port Authority of New York and NJ Data Analytics Project

BANL 6900-01 - Business Analytics Capstone

Answer the Project Questions

Goal 1: Top Five Factors Affecting Usage?

The usage of bridges and tunnels is mainly driven by five factors. First, payment method plays a major role facility with more EZPass users move traffic much faster than those with cash lanes. Second, toll violations affect flow, and with 5.7 million violators in 2025, enforcement activity can slow lanes. Third, seasonality impacts demand, with summer months like July (13.9M vehicles) being the busiest and winter months like February (12.8M) being the slowest. Fourth, the type of vehicles matters: tunnels with more trucks, such as Lincoln and Holland, experience slower speeds. Finally, NYC holidays, events, and weekday patterns influence usage, with Thursdays and Fridays being the busiest days of the week.

Goal 2: Toll Violators by Year, Month, Week, Facility?

In 2025, there were 5,698,194 toll violators. Violations vary across months, peaking in May with 390,444 and dipping to 308,980 in January. Weekly patterns show that violators are highest from Thursday to Saturday. The facilities with the most violators include GWB Upper, GWB Lower, Lincoln, and Holland, which also have the highest traffic volumes. These trends help identify when and where enforcement should be strengthened.

Goal 3: Busiest Times & How Factors Affect Traffic and Speed?

Traffic is busiest during the summer, especially July, and slowest in winter, particularly February. Thursdays and Fridays consistently show the highest weekday traffic. Seasonality, holiday travel, and major NYC events cause noticeable spikes, while higher truck presence in tunnels leads to slower speeds. Months with more toll violators also show small slowdowns due to enforcement activity. Overall, traffic increases in summer and peaks before weekends, while speeds drop during high-demand and high-violation periods.

Goal 4: Congestion Effects of 2025 Pricing?

Congestion pricing caused a major shift in traffic patterns. Total traffic fell from 195.7 million in 2024 to 170.9 million in 2025, a drop of nearly 25 million vehicles. Priced crossings like Lincoln, Holland, and GWB Lower saw a clear decline in traffic, while lower-cost alternatives like Goethals and Outerbridge saw increases. This means drivers actively rerouted to avoid higher tolls. As a result, congestion decreased on priced routes but increased at cheaper crossings.

Goal 5: Forecasting Facility Usage Beyond 2025?

Using Azure AutoML, the XGBoost model predicts gradual growth in overall traffic, rising from 130.2M in 2025 to about 132.2M by 2030. The busiest facilities in the future will remain GWB Upper, GWB Lower, and Goethals, which are projected to handle the highest volumes. Even though congestion pricing caused a drop in 2025, long-term demand is expected to increase steadily as the region continues to grow.

Recommendations to the company

1. What are the critical factors to which they need to pay attention?

The Port Authority should closely monitor five critical operational and behavioral factors that strongly influence traffic flow, revenue, and congestion across bridges and tunnels.

A. **Payment Method Distribution (EZPass vs Cash)** - EZPass continues to be the strongest driver of faster throughput. Facilities with high EZPass adoption such as GWB Upper with 39.1 million yearly vehicles operate far more efficiently, while cash lanes consistently create slowdowns.

B. **Toll Violations & Compliance -** The dashboard clearly shows in 2025, there were 5.6 million violations, with monthly violation rates between 3.5% and 4.7%. Violations are especially concentrated at GWB Upper, GWB Lower, and Lincoln Tunnel, creating both revenue loss and operational inefficiencies.

C. **Seasonal & Weekly Traffic Patterns -** Traffic peaks during June–August, reaching up to 13.9 million vehicles per month, and is highest on Thursdays and Fridays (15.2%). Weekends see significantly lower usage. These patterns must guide staffing and lane allocation.

D. **Shifts Caused by 2025 Congestion Pricing -** After congestion pricing began in 2025, total traffic dropped from 195.7M to 170.9M (a decline of 24.8 million vehicles). Demand also shifted from Lincoln and Holland toward Goethals and Outerbridge, creating new potential pinch points.

E. **Long-Term Traffic & Violation Growth (2025-2030) -** Forecasts predict traffic will rise to 132.2 million vehicles by 2030, while violation rates may increase from 4.16% to 5.52%. This indicates future pressure on infrastructure, enforcement systems, and toll technology.

2. What can they do to improve their operations?

Based on our findings across all 5 project goals, the Port Authority can take the following high-impact actions.

A. **Accelerate EZPass Adoption -** Increase enrollment campaigns, add EZPass - only lanes during peak hours, and offer temporary incentives or retail pickup options. Increasing EZPass usage will directly reduce queue times at all major facilities.

B. **Strengthen Violation Enforcement & Recovery -** More ALPR cameras should be installed at high-violation locations. Enforcement teams should focus on months with high volumes (e.g., May with ~390K violations) and use automated reminders for unpaid tolls. Periodic amnesty programs can help recover lost revenue.

C. **Use Seasonal Staffing Models -** Increase staffing during summer months and on Thursdays and Fridays, when traffic peaks. Reduce staffing during slower months like February and weekends. Dynamic lane management (reversible, truck-restricted, or EZPass surge lanes) should be implemented to match real-time demand.

D. **Adjust Congestion Pricing Strategies -** Implement more granular peak-hour pricing and off-peak incentives for freight carriers. Because traffic shifted significantly in 2025, facility-specific adjustments must be reviewed annually to maintain balance across the network.

E. **Reinforce High-Load Facilities**
    - GWB Upper: 159.7M vehicles
    - GWB Lower: 145M
    - Goethals: 113.6M

These facilities should receive prioritized preventive maintenance, monitoring systems, and toll technology upgrades.

3. What additional data should they collect in the future?

To improve forecasting accuracy and operational efficiency, the Port Authority should collect.

- Lane-Level Speed and Congestion Data to identify exactly where bottlenecks are forming.
- Detailed Incident and Accident Logs, including timestamps, lane closures, and causes.
- Origin to Destination Data for both commuters and freight to understand routing patterns and facility preferences.
- Event and Tourism Activity Data, since NYC events cause predictable traffic spikes.
- Freight Commodity and Truck Type Data for more accurate modeling of commercial vehicle impacts.
- Enforcement Activity Logs to link violations with enforcement presence and timing.

4. What exogenous factors make sense to incorporate in their analyses?

Our analysis showed that external conditions also have a meaningful effect on traffic and violations. Future models should incorporate.

- Fuel prices, which influence both commuting and freight movement.
- Public transit reliability, since outages shift thousands of riders to bridges and tunnels.
- Weather factors such as storms, snowfall, fog, extreme heat, and high winds which can reduce traffic by 15 - 22% during major events.
- Regional employment and economic activity, which correlate with commuter traffic.
- Seasonal shipping patterns, particularly during Q4 when freight volumes rise by 8 - 12%.

5. Any other recommendations of value to the company

To support long-term success and operational resilience, we recommend the following steps.

- Build a real-time operations dashboard that integrates live traffic data, weather conditions, violation alerts, and predictive congestion forecasts. This would help transition from reactive to proactive decision-making.
- Enhance public communication by offering real-time travel times, suggested alternate routes, and congestion pricing updates. Better communication improves traffic distribution and reduces unexpected delays.
- Strengthen data governance to ensure all departments use standardized definitions, clean datasets, and shared reporting procedures.
- Expand predictive maintenance, especially for high-volume facilities like GWB Upper, GWB Lower, and Goethals. With traffic projected to reach 132.2M by 2030, preventive maintenance is essential to avoid costly disruptions.