Graduation Project Presentation Outline

Graduation Project – Data Analysis Track (Power BI)

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Presentation Time: 15 minutes

Title Slide

- Title: Analyzing and Forecasting Public Transportation Ridership Trends in New York (MTA)
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Project Background & Business Problem

- Brief business context:
    The COVID-19 pandemic caused severe declines in ridership, leading to financial losses and operational challenges for the MTA. Understanding how ridership is recovering is critical to improving service efficiency, optimizing resources, and ensuring the network's long-term sustainability.
- Problem Statement / Research Question Example: The MTA is facing critical challenges in understanding and optimizing post pandemic ridership recovery across its diverse transportation modes. Key issues include uneven recovery rates across different transportation services, fluctuating daily ridership patterns, potential operational inefficiencies, and the need to adapt services to new passenger behavior patterns. Understanding these dynamics is essential for resource allocation, service optimization, and strategic planning to ensure sustainable public transportation operations.

Project Objectives & Scope

Clear project goals Example:

1. **Comprehensive Recovery Analysis:** Clear insights into which transportation modes have recovered most effectively, and which need additional focus

2. **Ridership Pattern Identification:** Understanding of daily, weekly, and seasonal patterns that can inform service scheduling and resource allocation

3. **Predictive Capabilities:** Reliable forecasting models for future ridership estimation to support strategic planning

4. **Operational Recommendations:** Data-driven suggestions for optimizing service frequency, capacity allocation, and route planning

5. **Strategic Planning Support:** Evidence-based recommendations for long-term transportation infrastructure and service development

6. **Performance Benchmarking:** Established baselines and targets for measuring future transportation performance and recovery progress

Dataset Overview

- Source(s) of data: MTA dictionary, MTA

- Description of key tables, columns, and timeframes Example: MTA Ridership from 2020 to 2024 Including 7 means of transport and comparison between pre pandemic and after pandemic of total passengers Ridership

Data Cleaning & Preparation (Power Query)

- Data cleaning steps:

Search about missing or inconsistent values (Didn't find).

- Apply the **Unpivot** transformation in Power Query to restructure columns into rows for easier analysis.
- Standardize column names and data types.
- Create calculated measures in Power BI (e.g., Recovery Rate, total passengers, Year Over-Year Growth).
- Ensure consistency between time periods and modes of transport.
- Challenges & solutions Example: "Resolved inconsistent date formats by applying standardized transformation."

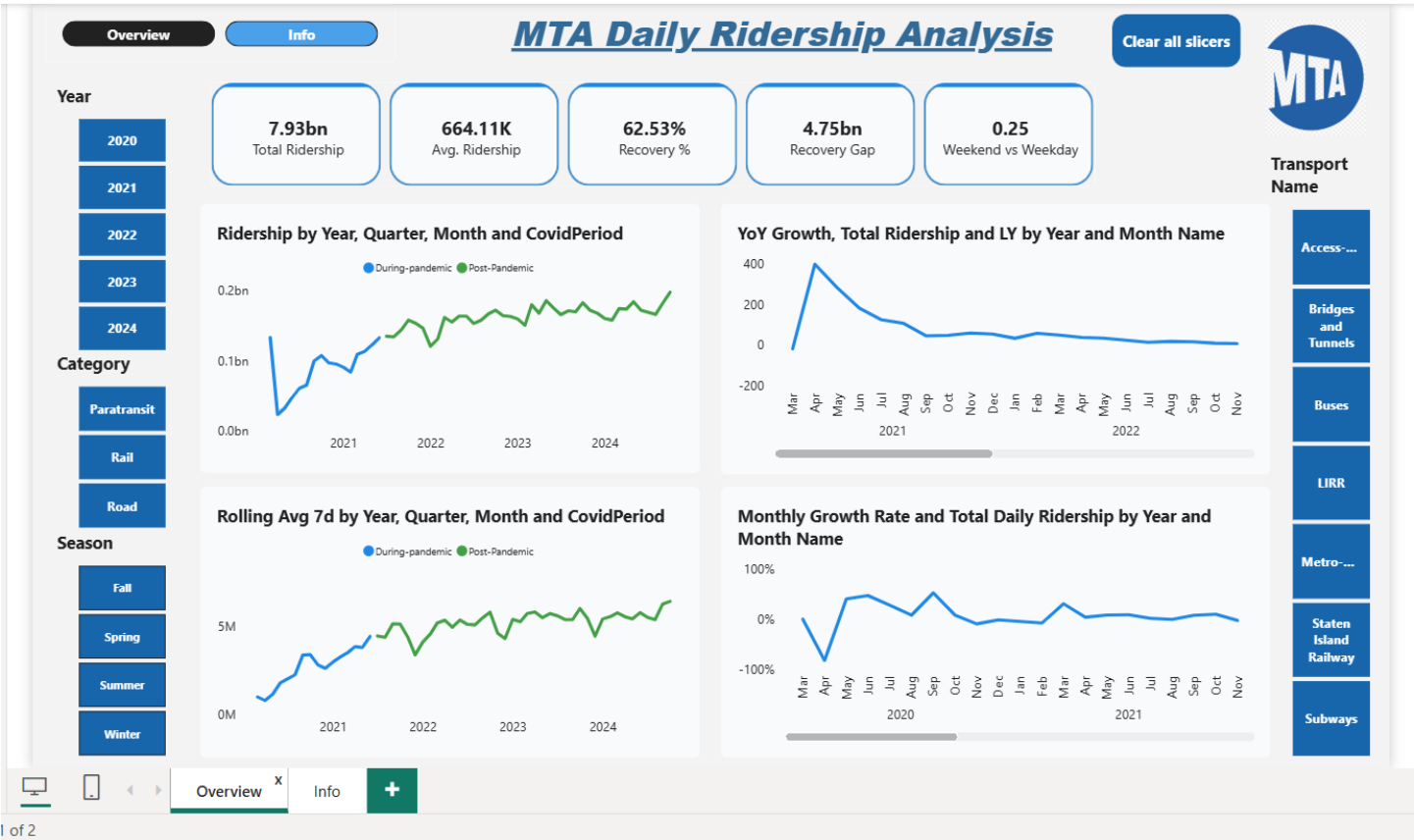## Data Model & Relationships

Diagram or schema of the data model:

o Performed Unpivot transformation on the main dataset to create a clean Fact Table containing three main columns.
o Created a Transport Dimension Table that includes Transport Name and Transport Type.
o Built a Calendar Dimension Table with the following fields: Year, Month Number, Month Name, Quarter, Week Number, Day Name, Date Type, Season, and COVID Period.
o Established relationships between the Fact Table and both Dimension Tables to form a Star Schema model by power Bi.

- Explanation of key table relationships

o fRidership table linked to dCalendar via Date column.
o fRidership table linked to dTransport Type via Transport name column.

Key KPIs & Metrics Defined

- List of key KPIs:

KPI	Purpose
Total Daily Ridership	Measure the total number of riders across all modes per day
Recovery Rate (% vs Pre-Pandemic)	Compare current ridership with pre-pandemic baseline
Top Transport Mode	Identify the most used transport mode on a given day/week/month
Monthly Growth Rate	Track month-over-month change in ridership
Ridership Share by Mode (%)	Distribution of ridership across modes
Daily Variance vs Monthly Average	Detect anomalies compared to the monthly average
Bridge & Tunnel Utilization (%)	Evaluate traffic recovery levels vs pre-pandemic
Week-over-Week Change (%)	Compare current week ridership with previous week
Forecasted Ridership (Next Month)	Predict next month's ridership using time series forecasting
Mode Dependency Index	Show dependency on a single mode (e.g., Subway)
Peak Ridership Day	Identify the highest ridership day within a time range
Mode-Specific Recovery Rate	Recovery % for each transport mode individually
Access-A-Ride Utilization (%)	Measure recovery for AAR (paratransit) users
Year-over-Year Growth Rate (YoY)	Compare ridership with the same period last year
Weekend vs Weekday Ratio	Measure how demand differs between weekdays and weekends

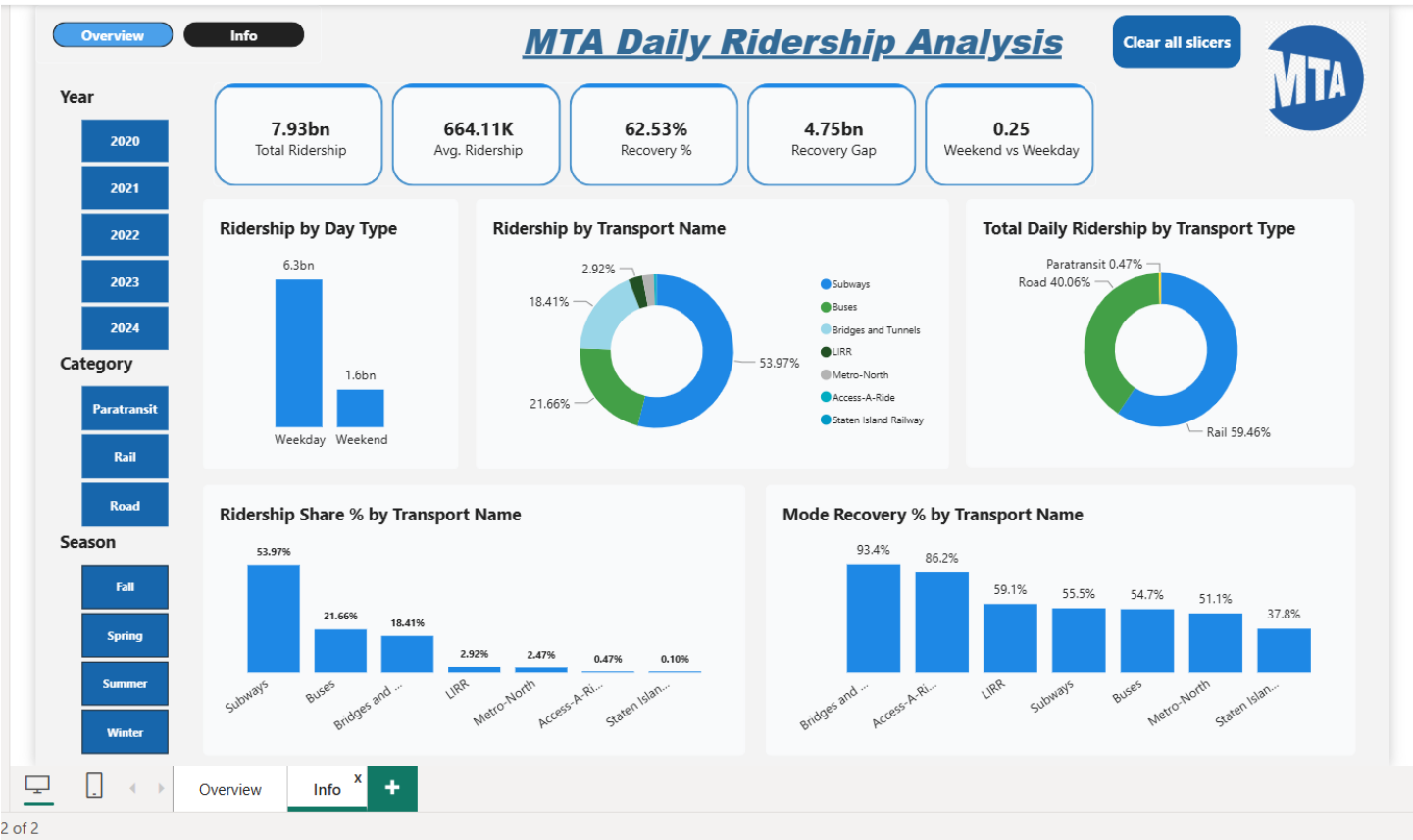# Dashboards & Visualizations (Power BI Demo or Screenshots)

Insights & Analysis

1. Post-Pandemic Recovery:

- The "Recovery % 62.53%" means that current total ridership is approximately two-thirds of the pre-pandemic volume.

- **Insight:** There is a strong, consistent upward growth trend since 2021, with total ridership jumping from the lows of 2020-2021 to 7.93 billion. The "Recovery Gap" of 4.75 billion quantifies the remaining challenge to reach pre-pandemic ridership levels.

2. Seasonal and Monthly Patterns:

- The time series charts show clear patterns influenced by seasons and specific months.

- **Insight:** Ridership consistently dips during the summer and winter months (likely around holidays and vacation periods) and peaks during the spring and fall. The YoY growth chart shows significant positive spikes in certain months (e.g., a peak of +400), indicating periods of accelerated recovery.

3. Growth Trajectory:

- The "YoY Growth" and "Monthly Growth Rate" charts track the pace of recovery over time.

- **Insight:** After the initial massive growth from the pandemic lows, the growth rates have likely become more moderate and stable, as seen in the charts post-2022. This indicates the recovery is maturing and entering a new phase.

4. Ridership by Day Type

- **Weekdays** account for **6.3 billion riders**, while **weekends** represent only **1.6 billion**.

- **Insight:** Transit usage is primarily driven by work and school commutes, with a noticeable drop during leisure days.

5. Ridership by Transport Type

- **Rail** services dominate with **59.46%** of total daily ridership.

- **Road** transport contributes **40.06%**, and **Paratransit** represents a minimal **0.47%**.

- **Insight:** Rail infrastructure remains the backbone of urban mobility.

6. Ridership by Transport Name

- **Subways** lead with **53.97%** of total ridership, followed by **Buses (21.66%)** and **Bridges & Tunnels (18.41%)**.

- Other modes like **LIRR**, **Metro-North**, **Access-A-Ride**, and **Staten Island Railway** contribute less than **3%** combined.

- **Insight:** The subway system is the core transport mode for daily commuters, while regional or specialized systems have limited ridership share.

7. **Mode Recovery % by Transport Name**

- **Bridges and Tunnels** have the highest recovery rate at **93.4%**, followed by **Access-A-Ride** at **86.2%**.

- **Staten Island Railway** shows the lowest recovery at **37.8%**.

- **Insight:** Vehicle-based and specialized services have recovered faster, while local and regional trains lag behind.

Patterns and Trends

- A clear and positive long-term trend of ridership recovery from 2021 to 2024.

- Strong **weekday dependency** highlights routine-based commuting patterns.

- The **large recovery gap (4.75bn)** indicates ongoing effects from remote work or behavioral shifts in travel habits.

- **Recovery rates vary greatly** across transport types, reflecting uneven demand recovery within the network.

- Recurring seasonal patterns with predictable dips and peaks throughout the year.

- **Outlier:** The years 2020 and 2021 are clear outliers (not fully shown but implied) due to the dramatic impact of the COVID-19 pandemic, which caused a massive drop in ridership.

Recommendations

Boost Weekend Ridership

- Launch promotional fares or weekend passes to encourage non-work travel.

- Partner with tourism and event organizations to increase leisure-related transit use.

Support Underperforming Modes

- Focus on improving service reliability and awareness for **Staten Island Railway** and **Metro-North**, which show lower recovery rates.

- Conduct targeted marketing or community outreach in low-recovery regions.

Enhance Subway and Bus Experience

- Since **Subways and Buses** represent over 75% of total ridership, improving safety, cleanliness, and schedule frequency could strengthen customer confidence.

- Introduce real-time tracking and digital communication to enhance user experience.

Close the Recovery Gap

- Analyze post-pandemic travel behaviors to understand where riders have shifted (e.g., remote work, ride-sharing).

- Adjust capacity planning and service schedules accordingly to optimize operational efficiency.

Sustain High-Recovery Modes

- Maintain strong performance in **Bridges & Tunnels** and **Access-A-Ride** by ensuring continued funding and service consistency.

- Use successful recovery models from these modes as best practices for others.

Data-Driven Decision Making

- Continuously monitor ridership trends by season and year to identify emerging patterns early.

- Leverage Power BI dashboards for real-time performance tracking and strategic planning.

Conclusion & Key Takeaways

The MTA Daily Ridership Analysis highlights a significant post-pandemic recovery challenge, with overall ridership reaching **62.53%** of pre-pandemic levels. Through detailed Power BI visualizations, we identified strong weekday dependency, rail system dominance, and uneven recovery across transport modes.

Our analysis shows that focusing on underperforming lines such as **Staten Island Railway** and **Metro-North**, while enhancing weekend travel incentives, can help bridge the **4.75bn recovery gap**. Additionally, maintaining the high performance of **Bridges & Tunnels** and **Access-A-Ride** can serve as models for broader network improvement.

Key takeaway: By implementing data-driven strategies and targeted initiatives, MTA can accelerate its recovery and potentially achieve a **20–25% increase in ridership** within the next cycle — restoring system resilience and improving commuter satisfaction.