Insights from Transport Dataset

1. Passenger Flow Peaks & Valleys

Weekdays, especially Tuesdays and Wednesdays, show a consistent spike in total passengers across all service types, suggesting mid-week travel hustle. Weekends dip sharply — a classic yet key insight for optimizing resource allocation & scheduling dynamic fleets.

2. Service-Type Usage Trends

Local Route dominates passenger counts, but Light Rail and Rapid Route show steady growth in monthly rolling averages, hinting at modal shifts towards faster, premium services. School services predictably spike during term-time months (March-June, September-November), highlighting seasonal demand cycles.

3. Rolling Averages Reveal Emerging Patterns

Rolling 3-day averages smooth out daily volatility and reveal hidden upward trends in Peak Service usage, indicating a potential recovery or surge in commuter demand post-pandemic.

4. Anomalies & Outliers

Sharp dips in passenger numbers on specific dates could correlate with public holidays or weather events. Integrating external data can validate these anomalies for proactive contingency planning.

5. Data-Driven Opportunity Zones

The consistent under-utilization of the ‘Other’ category (median < threshold) suggests potential for service repurposing or marketing campaigns to boost ridership and revenue in niche segments.

"Harnessing these actionable insights empowers transport operators to innovate with precision, driving operational efficiency and enriching commuter experience through data-centric strategic planning."

Forecast Report from Transport Services

Objective

To forecast passenger journeys for the next 7 days across the following service types:
- Local Route
- Light Rail
- Peak Service
- Rapid Route
- School

Model Used: Prophet

Chosen for its intuitive handling of time series data with seasonality, holidays, and trend shifts — a no-nonsense, future-facing ally.

Model Parameters & Rationale

Parameter	Value	Why It Matters
daily_seasonality	True	Captures fluctuations in daily ridership patterns.
changepoint_prior_scale	0.5	Moderate flexibility to detect trend shifts.
seasonality_mode	additive	Suitable for non-multiplicative trends seen in transport data.
holidays	Included	Public holidays integrated to account for anomalies.

Observations & Trends

- Weekdays continue to dominate — especially Local Route and Peak Services — aligned with work and school travel surges.
- School Services spike post-weekend, confirming term-time weekday demand.
- Light Rail and Rapid Routes show steady growth; optimization potential through enhanced frequency.
- Saturday and Sunday dip across the board — perfect for resource reallocation or off-peak promotions.

Technical Report: Forecasting Public Transport Passenger Journeys Using Facebook Prophet

Model Chosen: Facebook Prophet (Additive Time Series Forecasting Model)

Use Case: Forecasting daily passenger journey counts for the following service types over the next 7 days.

Why Facebook Prophet?
Facebook Prophet is an open-source forecasting tool developed by Meta, designed to handle time series data with strong seasonal effects. Its simplicity, scalability, and interpretability make it ideal for business-centric datasets such as public transport passenger journeys.

Model Components:
Prophet uses an additive model defined by:

$y(t) = g(t) + s(t) + h(t) + \varepsilon(t)$

Where:

- g(t): Trend function modeling non-periodic changes.
- s(t): Seasonality (daily, weekly, yearly cycles).
- h(t): Effects of holidays or special events.
- ε(t): Error term (noise).

Key Parameters Used:

Parameter	Description	Value
changepoint_prior_scale	Controls flexibility of trend changepoints	0.1
seasonality_mode	Seasonality type	Additive
weekly_seasonality	Capture weekly cycle	True
yearly_seasonality	Capture yearly cycle	False

Parameter	Description	Value
daily_seasonality	Capture daily pattern	True

Modeling Steps:

1. Convert raw dataset to Prophet's required format with columns: ds (date), y (passenger count).
2. Train the model on historical data from each service type.
3. Generate forecasts for the next 7 days.
4. Visualize forecast, trend, and seasonality components.

Key Findings from Prophet Outputs:

- Clear weekly seasonality observed with higher usage on weekdays.
- Peaks detected during morning and evening rush hours.
- Drop in usage on weekends and holidays.

Conclusion:
Facebook Prophet provides a scalable and intuitive solution for short-term forecasting of public transport usage. Its interpretability and ease of use make it a strong choice for this dataset, allowing stakeholders to make data-driven scheduling and resource allocation decisions.