Aadhaar Mobility Intelligence Dashboard

Unlocking Societal Trends in Aadhaar Enrolment & Updates

Problem Context

- India exhibits high internal mobility driven by:
  - Education transitions
  - Workforce relocation
  - Urban absorption
- Traditional datasets are infrequent (Census, NSSO)
- Aadhaar updates create a high-frequency proxy for demographic transitions

Hackathon Problem Statement

Goal:

- Identify meaningful patterns, trends, anomalies or predictive indicators from Aadhaar updates
- Translate into insights that support:
  - Informed decision-making
  - System improvements
  - Policy & planning

Datasets Used

Provided datasets:

- Aadhaar Enrolment
- Aadhaar Demographic Updates
- Aadhaar Biometric Updates

Attributes:

- State, District, PIN
- Age bands: 0–5, 5–17, 18+
- Modalities: demographic & biometric

Pipeline Overview

1. Data Ingestion & Cleaning
2. Mobility Signal Extraction
3. Clustering (Insight Layer)
4. Forecasting (+3 month horizon)
5. Decision Dashboard (Streamlit)

Phase-1: Ingestion & Cleaning

- Chunked CSV loading (low memory)
- Date normalization
- PIN $\rightarrow$ District aggregation
- Parquet for efficient access

Phase-2: Mobility Signal Extraction

Extracted indicators:

- **movement_index** (adult mobility)
- **student_ratio** (education transitions)
- **bio_student** & **bio_adult**
- **month_index**, **quarter**

Outputs:

- Monthly aggregated mobility table

Phase-3: Clustering (Optional)

KMeans + PCA archetypes:

- Metro Absorption Hubs
- Stable Districts
- Student Migration Hubs
- Economic Origin Belts

These offer policy interpretation.

Phase-4: Forecasting (+3 Months)

Model:

- RandomForestRegressor (interpretable & stable)

Targets:

- movement_index(t+3)
- student_ratio(t+3)

Backtest RMSE:

- Movement: 2638.76
- Student: 0.027

Phase-5: Decision Dashboard

Interactive Streamlit dashboard:

- District Explorer (vs State Mean)
- Hotspot Rankings (Absolute & Per-capita)
- Forecast Explorer
- State Comparison
- Insights (Policy Layer)

Key Findings

- Education is a strong, structured mobility driver
- Tier-2/Tier-3 hubs emerge in per-capita analysis
- Adult mobility absorbed by metropolitan districts
- Forecasting shows persistence at $+3$ months

Policy Implications

Supports planning in:

- Education & Skill ecosystems
- Urban housing & transport
- Migration corridor analysis
- Aadhaar system load forecasting
- State-level resource allocation

System Improvement Opportunities

For Aadhaar ecosystem:

- Seasonal update load prediction
- Age-cohort transition insights
- Digital service deployment planning
- Workforce & education corridor mapping

Future Work

- PIN-level micro mobility
- Multi-horizon forecasting (6–12m)
- OD corridor reconstruction
- Education-demand simulation

Conclusion

Aadhaar updates offer real-time signals for demographic transitions. This project demonstrates that:

- Mobility can be extracted & quantified
- Forecasting supports planning
- Insights align with system improvement goals

Thank You!
Questions?