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Developing Sketch Planning Models to Predict Regional Mode Share in India: An Analysis focusing on Urban Centers

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Presentation Structure

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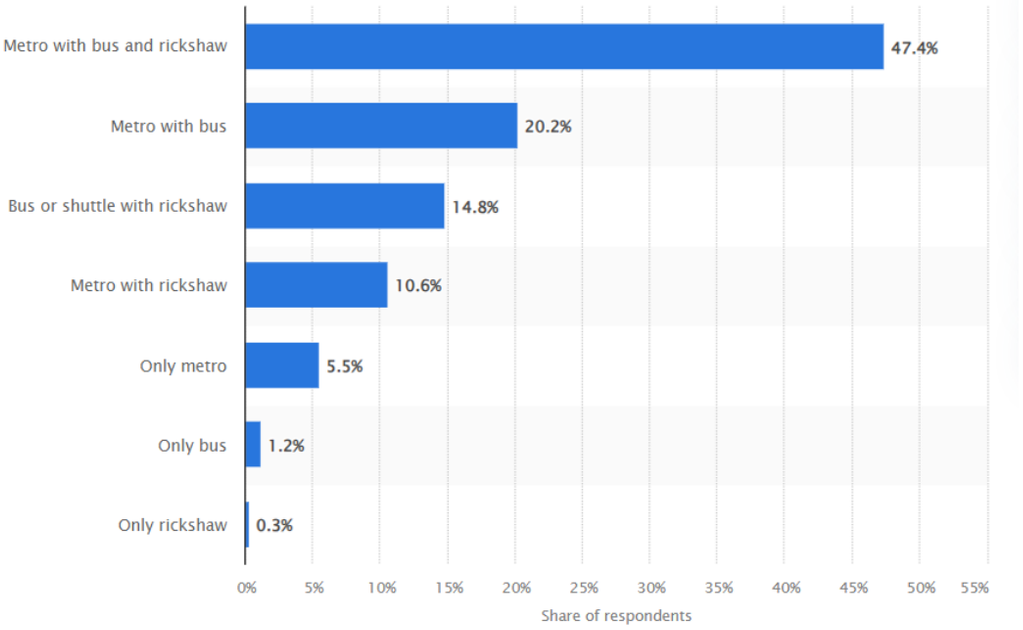
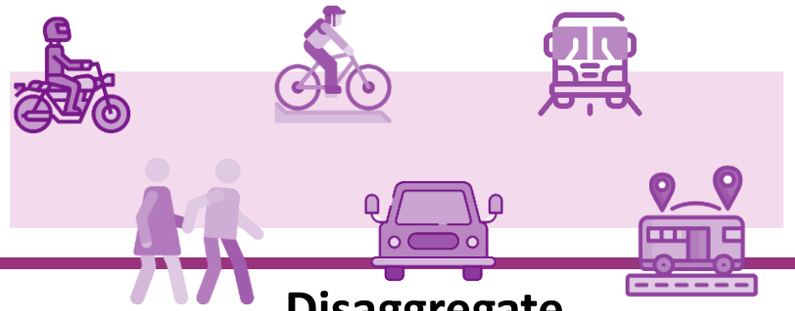
Introduction

1. Mode share is crucial for understanding **transportation behavior and planning** sustainable transport systems. It helps in evaluating the impact of **infrastructure investments and economic development** on transportation choices
2. Transportation planners often use **demand models** to predict how **regional-level land use, infrastructure, and demographic changes** may impact transportation systems (or vice versa).
3. Studying mode share is essential to **avoiding concentration on a mode of transportation**, promoting public transport, and reducing pollution.
4. Different researchers followed different **disaggregate models** to study the mode share at different locations.



Preferred mode of transit by commuters in India as of January 2023

Research Background



Disaggregate

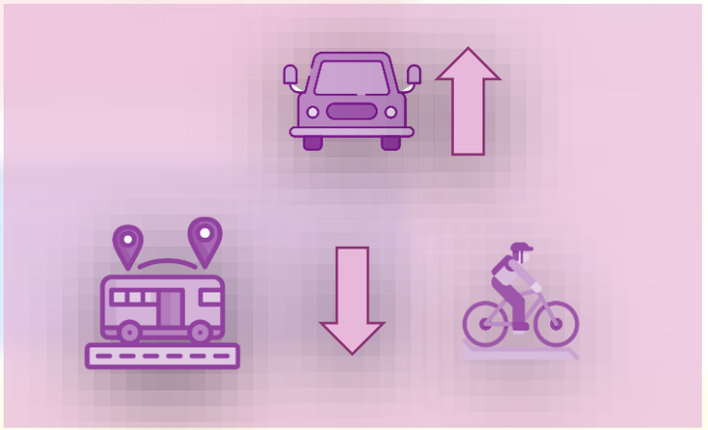
Individual-level (Disaggregate) Models

- Mode choice has been extensively studied and is found to be influenced by both infrastructure investment and socioeconomic factors, although socioeconomic factors may have a slightly greater impact.
- Trip length is another factor that helps in the decision on the choice of a specific mode.
- Discrete choice analysis is one of the widely used models in mode choice research to predict the likelihood that a given person will choose to commute to and from work via a private vehicle, public transportation, bicycle, or walking on the disaggregate level.

Aggregate

Region-level (Aggregate) Mode Share

- On the basis of aggregate data at several spatial scales (such as census tracts, zip codes, and electoral wards) or community levels (such as cities and metropolitan regions), prior research has also directly forecasted mode shares.
- Aggregate models include factors like roadway network patterns, land use mixture, multimodal amenities, socioeconomic characteristics, and spatial features to study the mode share by different vehicle class.



Joint qualitative correlation among vehicle classes

Use and Importance of Fractional Multinomial Logit Model (FMNL)

- It considers all modes of transportation together and helps to find the importance of explanatory variables in each mode of transportation.
- It helps to proportionally distribute the share of each mode in a region using the publically available datasets.
- FMNL model helps to study the cumulative mode choice for the allocation of trips to different vehicle classes.

Data Description

Data Source	Attributes	Description
Black Marble ***(July 2008–June 2009 and July 2014–July 2015)***	Night time Light	Mean of nighttime light in each district
MOSPI ***(NSSO survey 72nd round of survey, July 2008–June 2009 and July 2014–July 2015)***	Mode share	Distinct mode choices available for travel
	Literacy Percentage	Percentage of literate population in each district
Census 2011	Population size	Number of people in each district
	Male Population Size	Number of males in each district
	Female Population Size	Number of females in each district
	Population Density	Number of people per sq. km in the district
	Scheduled Caste Population Size	Number of people belonging to Scheduled caste in each district
	Scheduled Tribe Population Size	Number of people belonging to Scheduled tribe in each district
PMGSY GeoSadak **(PMGSY National GIS-Open Data)**	Road Length	Kilometre of road network existing in each district
DHS ***(Demographic and Health Surveys (DHS) for the year 2015)***	Household Car/Truck Ownership	Number of cars owned by the household
	Household Bicycle Ownership	Number of bicycles owned by the household
	Household Motorcycle Ownership	Number of motorcycles owned by the household
Rural Health Statistics Rural Health Statistics dataset	Sub Centres	First point of contact between primary health centre and community
	Public Health Centres	State owned rural and urban care facilities
	Community Health Centres	Consumer directed healthcare organisation
	Sub-Divisional Hospital	Hospital at secondary referral level responsible for sub district
	District Hospital	Hospital at secondary referral level responsible for district

Methodology

- **Step 1:** Regional mode share estimates based on 2015 national survey using FMNL
- **Step 2:** Regional mode share estimates based on 2009 national survey using FMNL
- **Step 3:** Mode share triads and their underlying associations in the year 2009 and 2015

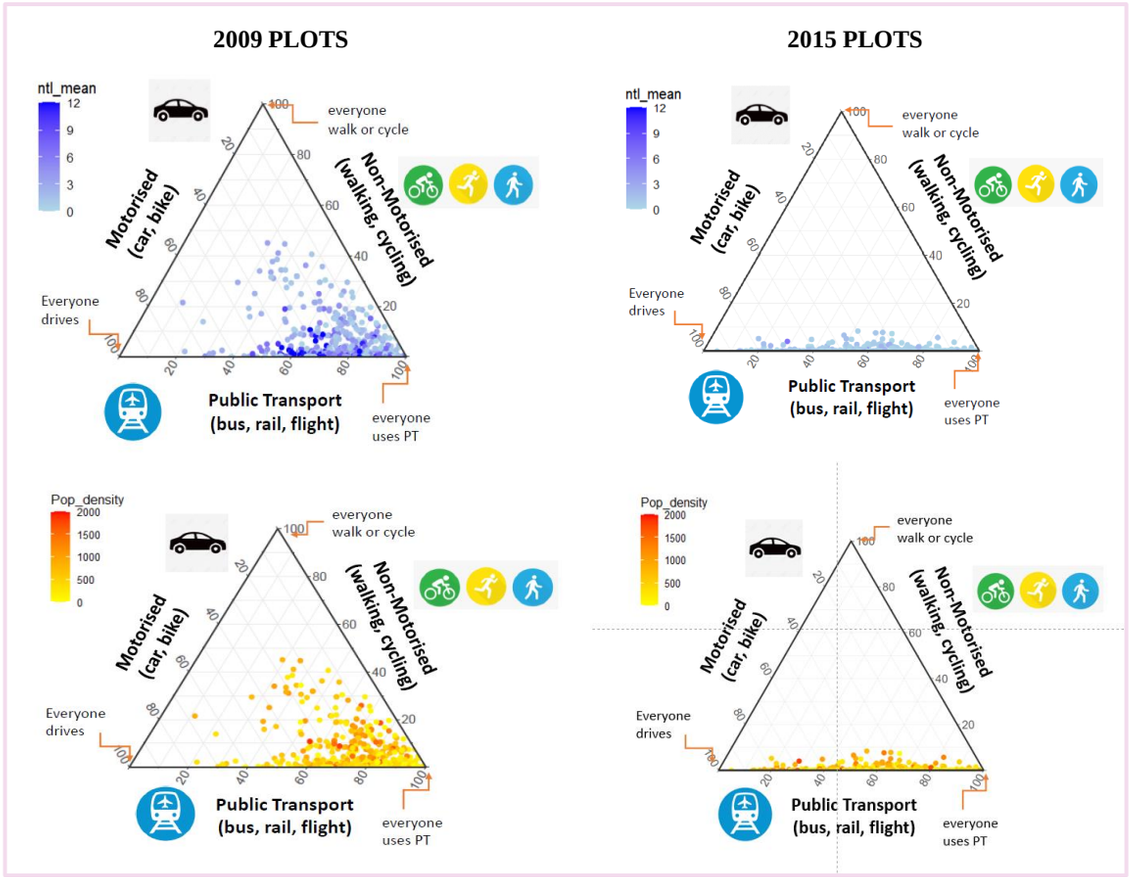
FMNL

The logistic function is used by the Fractional Multinomial Logit (FMNL) model to express the anticipated value of y_{ij} for a given mode j as follows:

$$E(y_{ij}|X_i) = \frac{\exp(\beta_j X_i)}{\sum_{j=1}^{J} \exp(\beta_j X_i)}$$

where β_j is the vector of parameters corresponding with each explanatory variable in X_i.

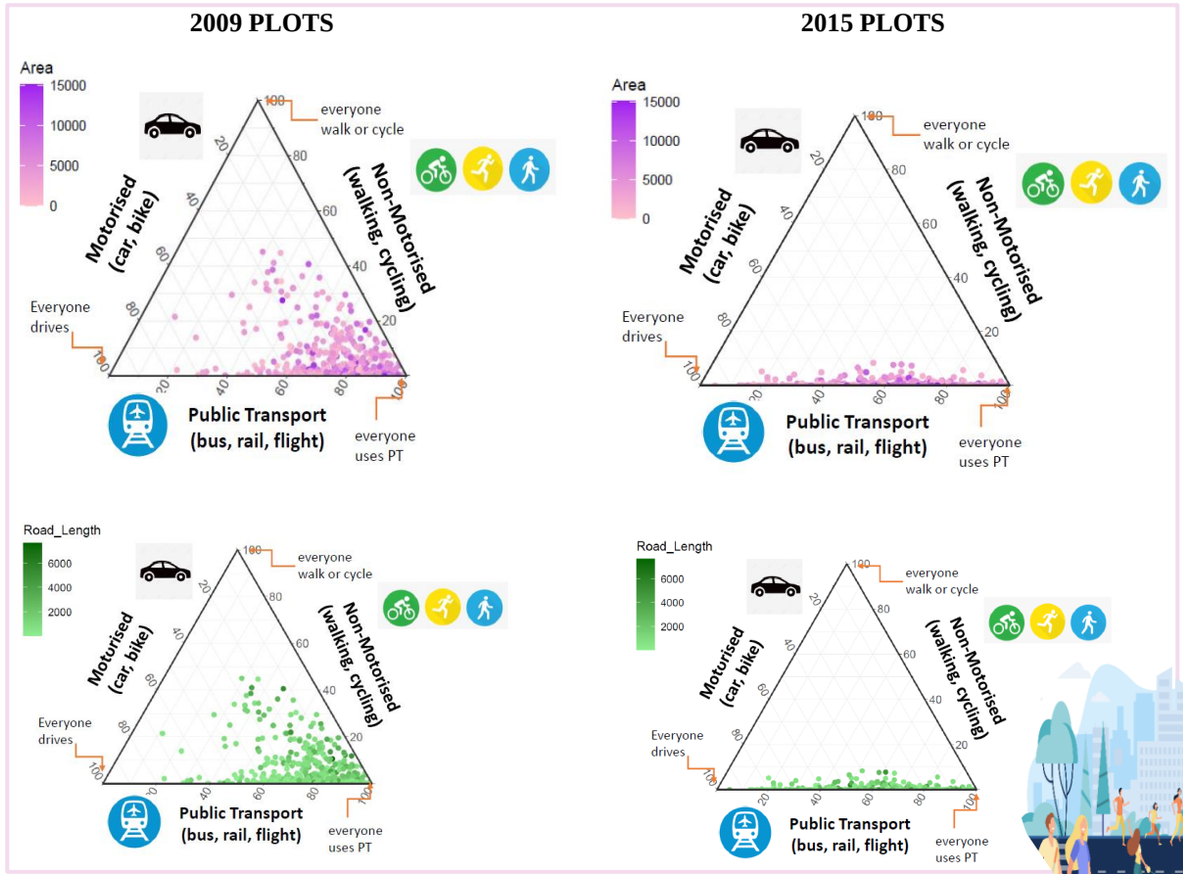
Result



Ternary plots illustrate the variation of public, motorized, and non-motorized transport across different districts.

2015 the irrespective of all the variable people aligning to motorized mode of transportation

Variable Name	Increase	Decrease
Ntl_mean	Public & Motorized	Non-motorized
Pop_Density	Non-motorized & Motorized	Public
Area	Public & Non-Motorized	Motorized
Road_Length	Public & Non-Motorized	Motorized



Conclusion

- The study provides valuable insights into the dynamics of regional mode share in India. Emphasizes the need for data-driven policy decisions to promote sustainable transportation options.
- Infrastructure Investment: Linked to increased modal share of air and rail transport, while decreasing non-motorized transport
- Health Infrastructure Development: Associated with reduced rail and bus usage, indicating a decline in long-distance travel needs for medical purposes
- **Non-motorized transport was more prominent in 2009 but decreased by 2015 due to economic growth and increased motorized transport availability**
- Enhance non-motorized transport shares by expanding road length and improving safety.
- Increase investment in public transport infrastructure, especially in areas with lower car ownership

Future Work

- This study lays the groundwork for future multimodal demand estimating models that are more robust and still easily accessible.
- Incorporate the latest datasets for more robust multimodal demand estimating models

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THANK YOU