Modeling Public Transit

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Public Transit Benefits

- Relieve congestion
- Save energy
- Reduce pollution
- Revitalize cities
- Mobility to disadvantaged, and
- Basic mobility option for everyone

PT Models

- Access / egress trips – no consideration
- Zoning – catchment areas not truly represented
- Importance - quality of service and in vehicle travel time
- Limitations in modeling behavior
- Nesting insensitive to commuters’ choice

Public Transit - Issues

- Access and egress
  - weakest part of a multimodal public transport chain
  - Substantial contribution to total travel disutility [1]
  - Weightings for walking times to and from bus stops and stations range between about 1.4 and 2.0 units of in-vehicle time, with no obvious dependence on trip type and main mode.
  - Similar range of 1.3 – 2.1 for access and egress journeys by all means (including driving and cycling to stations, etc.) [2].

[1] Krygsman, S., Dijst, M., & Arentze, T. (2004) 'Multimodal public transport: an analysis of travel time elements and the interconnectivity ratio', *Transport Policy*, 11, (3) pp. 265-275

[2] Givoni, M. & Rietveld, P. (2007) 'The access journey to the railway station and its role in passengersâ€™ satisfaction with rail travel', *Transport Policy*, 14, (5) pp. 357-365

Public Transit - Issues

- Access and egress
  - – determine the availability (or the catchment area) of public transport [3].
  - – time and distance discomfort associated with access and egress – unimodal trips relatively attractive [4,5].

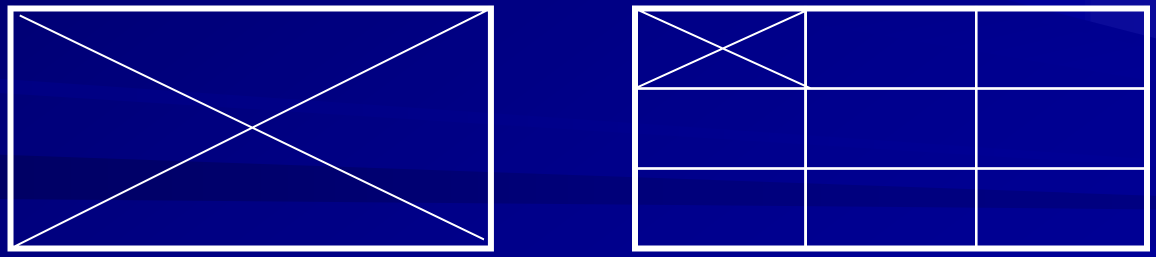
[3] Bovy, P.H.L., Van der Waard, J. and Baanders, A. (1991) ‘Substitution of travel demand between car and public transport: A discussion of possibilities’ Proceeding of PTRC seminar.

[4] Murray, A.T. (2001) ‘Straategic analysis of public transport coverage’. Socio –Economic planning sciences, volume 35, pp. 175-188.

[5] Ortuzar, J.D.D. and Willumsen, L.G.(2002) ‘Modelling Transport’ 3rd edition John Wiley &Sons, West Sussex, England.

Public Transit - Issues

- Zoning
  - – Increase No of TAZs
    - spatial precision in a traffic assignment increased
    - Centroid connectors - shorter and less arbitrary
    - intrazonal trips decreased
    - estimates of measures of effectiveness (MoEs) - more precise.
    - increased computational effort
    - more precision in data collection [6]



[6] Horowitz A.J. (2001). 'Computational Issues in Increasing Spatial Precision of Traffic Assignments' Transportation Research Record 1777, Paper No. 01-0259

Public Transit - Issues

- Travel behavior
  - time and cost
  - Comfort
  - number of transfers
  - Age
  - urgency of making the trip
  - reliability of different modes
  - Safety - differs at a different period of time and for different type of users (gender, age), etc.

Case Study of Delhi

- **Conventional traffic zone system by RITES**
  - Study area Delhi divided in 208 TAZs
  - geographical centres as centroids
  - Centroids connected to nearby roads through connectors

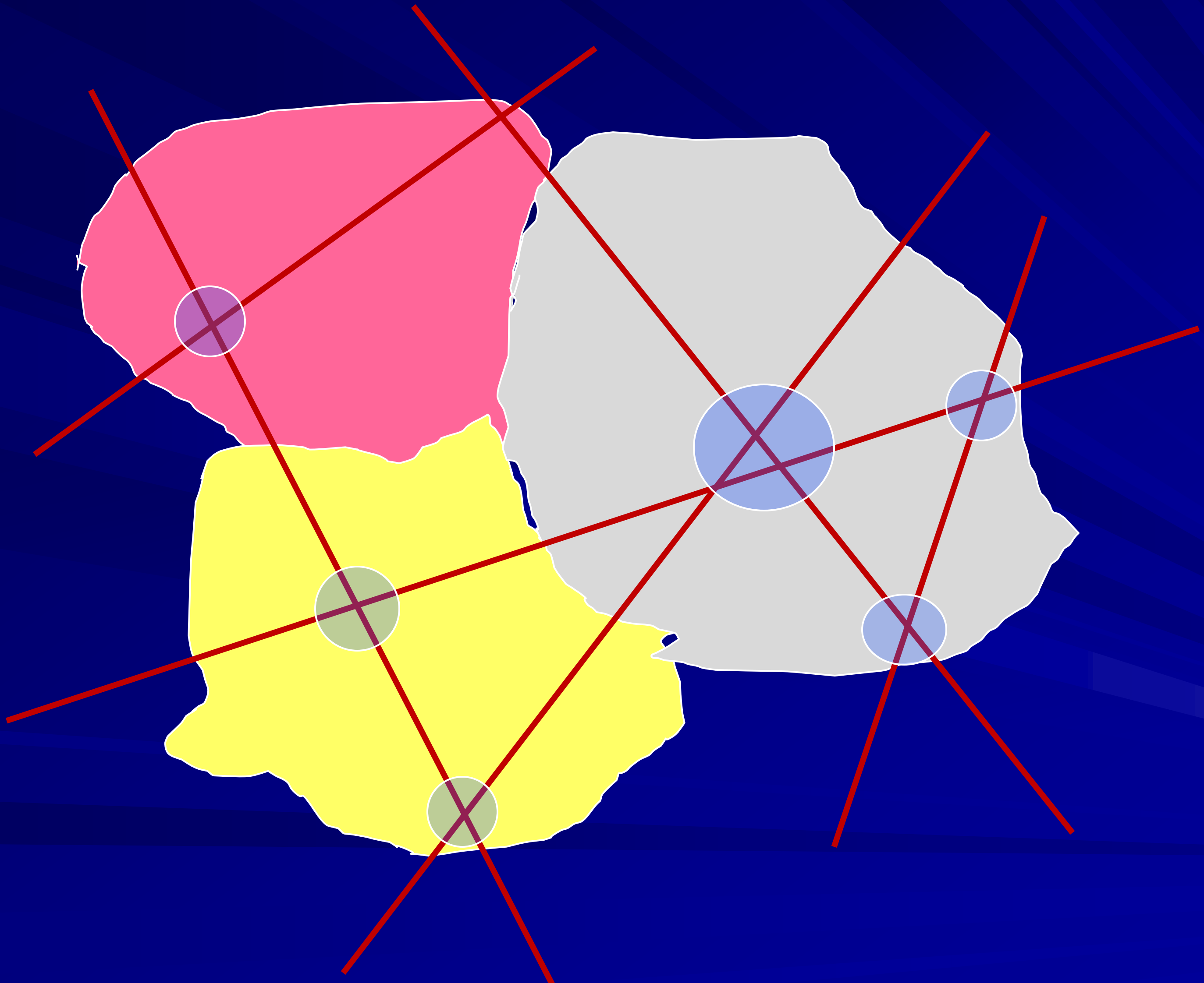
TAZs Based on Service Area

- Accepted walking distance (generally 0.5 km)
- The length of accepted distance varies -economic and physical condition of commuter.
- some area may remain outside any zone and some area may be covered by more than one traffic zone (overlapping buffer area).

TAZs around transit stop/station

- Study area has been divided in zones by assigning each unit of area to the nearest bus stop/metro station.
- zones based on nearest transit stop / station - Since zoning based acceptable walking distance does not reflect commuters choice behavior
- Zoning not around links (routes of buses and metro) - commuters board at stop / station

Zoning – nearest transit stop



*Using GIS tools

Differences in Zoning Methods

	Conventional zones	Based on transit service
Origins / destinations	Geometric centroids are origins / destinations	Actual intersections are the origins / destinations
Connectivity of centroids	Artificial connectors from centroids to intersections are required	No artificial connectors required
No of zones	208 zones based on major arterial roads (RITES, 2001)	2201 zones based on service area of transit stop / station
mean access and egress for 679 commuters interviewed	3.36 km	2.50 km

Data Collection and Modeling

Commuters Survey:

- Metro Commuters
- Bus commuters
- Car commuters
- Two-wheeler commuters

Multinomial and Nested Logit Modeling

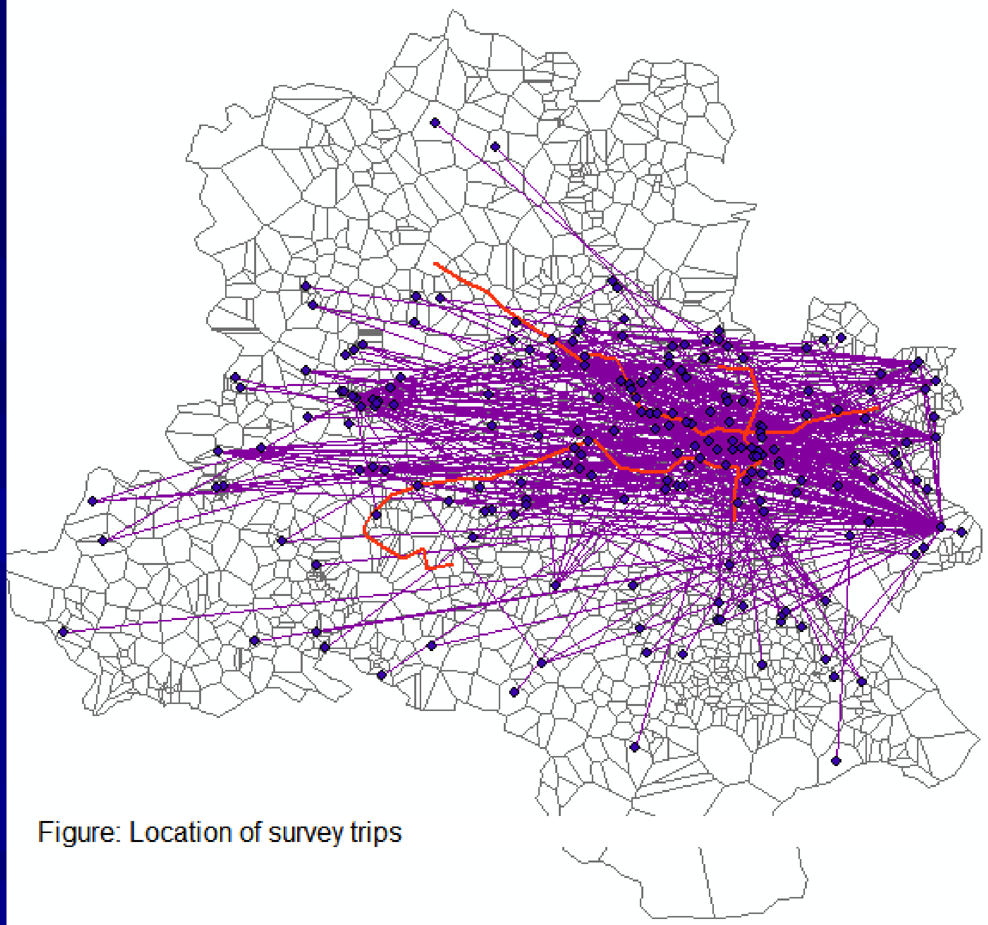


Figure: Location of survey trips

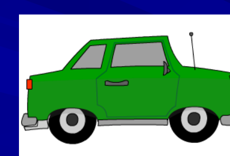
Choice Modeling

- Mode choice model for trips
  - Main mode of travel by motorized modes
  - Entire trips by walking, bicycles, taxi and three wheelers not included
  - Nine choices considered

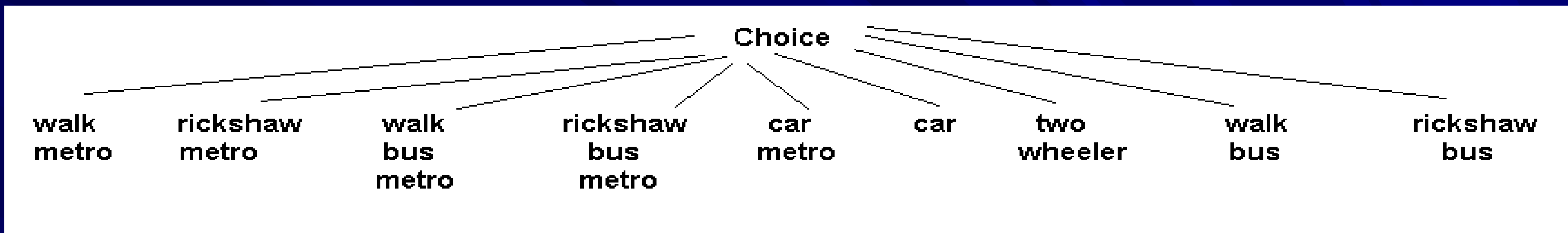




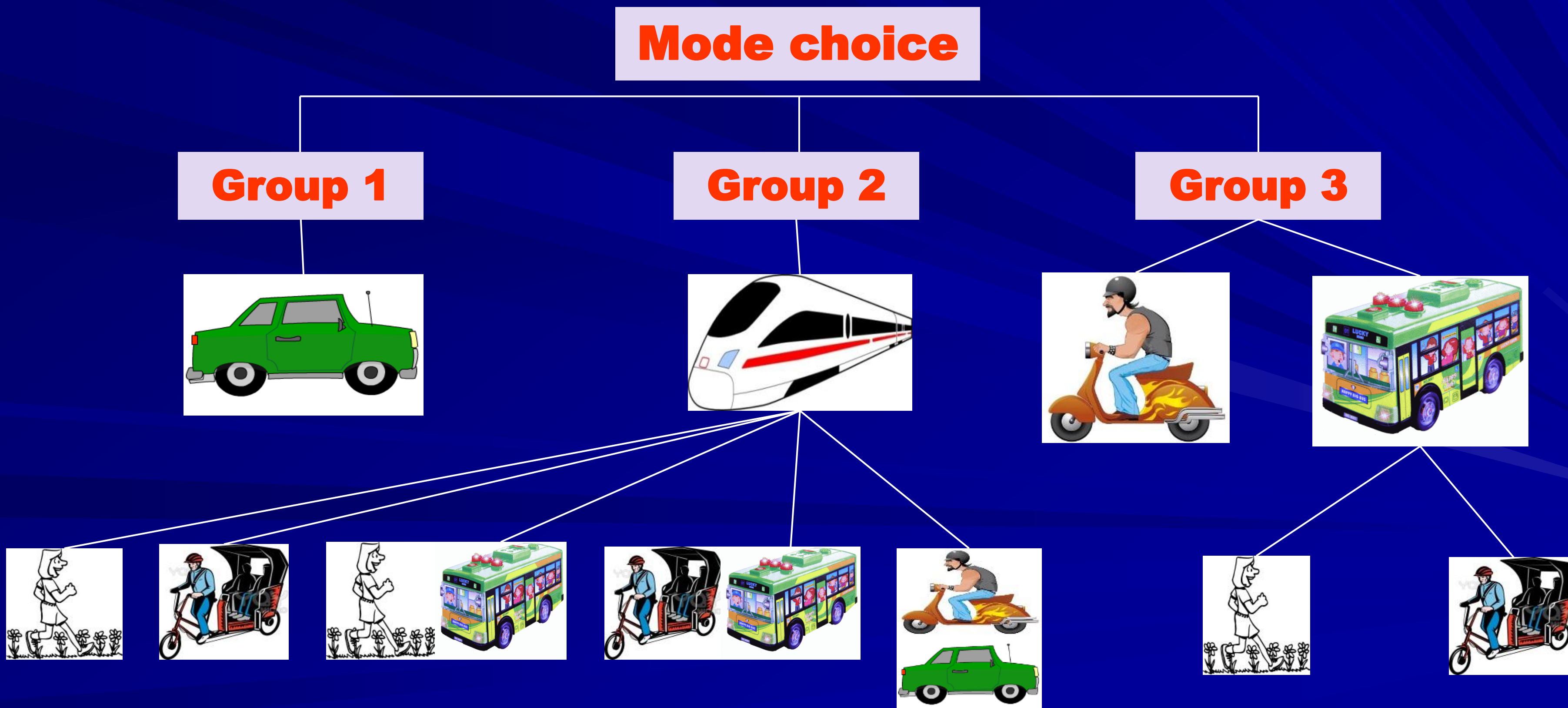



Model structures



Final Nest



Scenarios based on speed

Different scenarios for estimating the ridership for different modes including public and private vehicles, have been developed.

- Improvement in speeds of vehicular traffic:
  - Expanding the road infrastructure along with creation of signal free junctions.
- Reduction in speeds of vehicular traffic:
  - More vehicles on the road

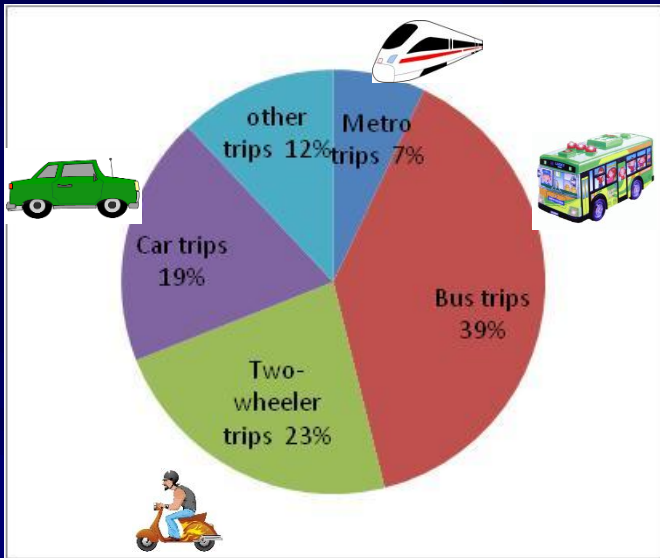
Scenario 1 – Increase in speed

	208 zones			2201 zones		
Modes		% of total			% of total	% of metro
Metro trips	1385736	7.05	% of metro	3011900	15.33	
Walk-metro	454390	2.31	32.79	1113254	5.67	36.96
Rickshaw-metro	209893	1.07	15.15	496644	2.53	16.49
Walk-bus-metro	304558	1.55	21.98	637264	3.24	21.16
Rickshaw-bus-metro	226938	1.16	16.38	346810	1.77	11.51
TW or car – metro	189957	0.97	13.71	417928	2.13	13.88
Bus trips	7669286	39.04	% of bus	8146936	41.47	% of bus
Walk-bus	5828461	29.67	76.0	6104462	31.08	75.0
Rickshaw-bus	1840825	9.37	24.0	2042473	10.40	25.0
Two-wheeler trips	4496195	22.89		3173722	16.16	
Car trips	3734915	19.01		2953573	15.04	
other trips	2357199	12.00		2357199	12.00	
Total trips	19643331	100		19643330	100	

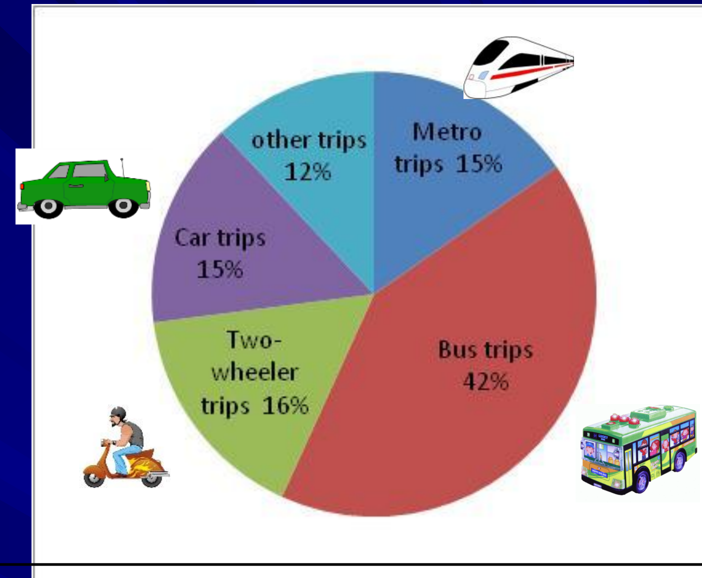
Scenario 2 – Decrease in speed

	208 zones			2201 zones		
Modes		% of total			% of total	% of metro
Metro trips	3172656	16.15		4337963	22.08	
Walk-metro	943423	4.80	29.74	1510287	7.69	34.82
Rickshaw-metro	655937	3.34	20.67	651761	3.32	15.02
Walk-bus-metro	577060	2.94	18.19	832761	4.24	19.20
Rickshaw-bus-metro	532385	2.71	16.78	506014	2.58	11.66
TW or car – metro	463851	2.36	14.62	837140	4.26	19.30
Bus trips	7084784	36.07		7648220	38.94	
Walk-bus	5409609	27.54	77.0	5674247	28.89	74.0
Rickshaw-bus	1675174	8.53	23.0	1973973	10.05	26.0
Two-wheeler trips	3953092	20.12		2887532	14.70	
Car trips	3075599	15.66		2412416	12.28	
other trips	2357199	12.00		2357199	12.00	
Total trips	19643330	100		19643330	100	

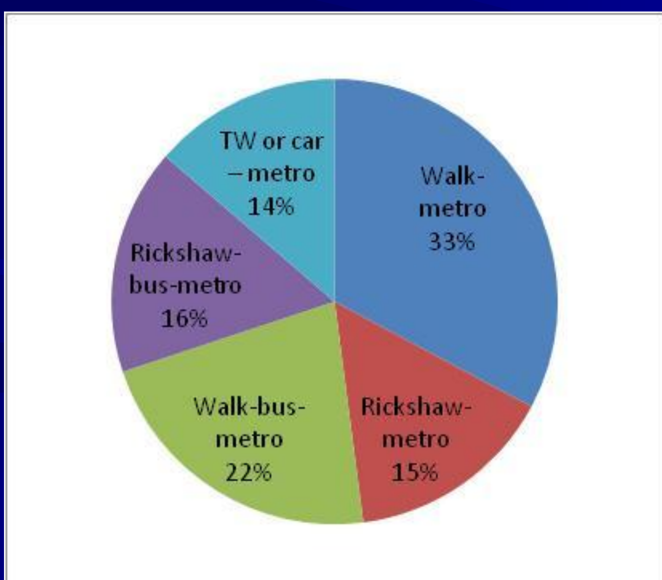
Scenario 1 – Increase in speed



distribution of all trips

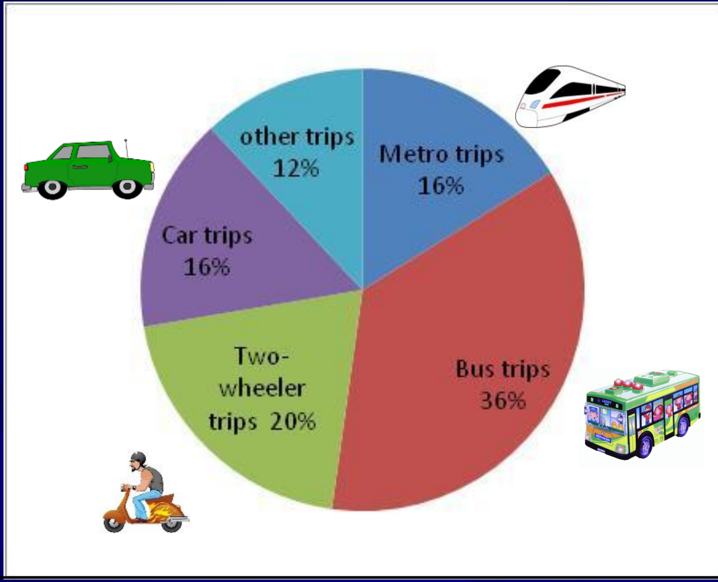


208 zones	2201 zones

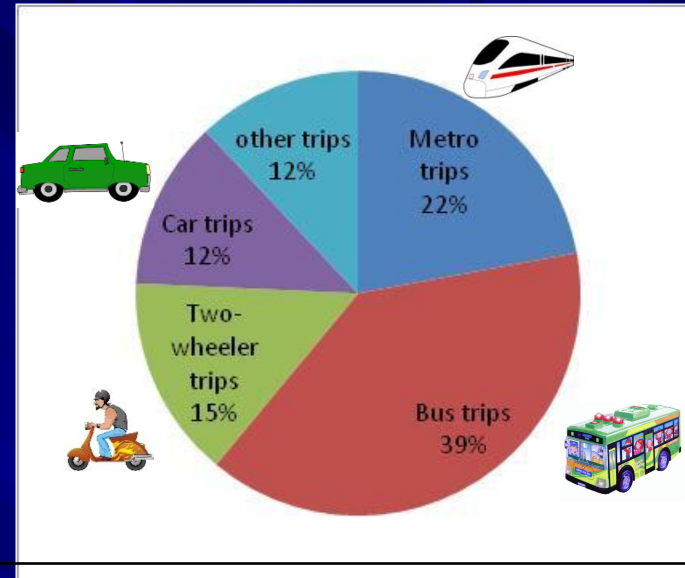


distribution of metro trips

Scenario 2 – Decrease in speed



distribution of all trips



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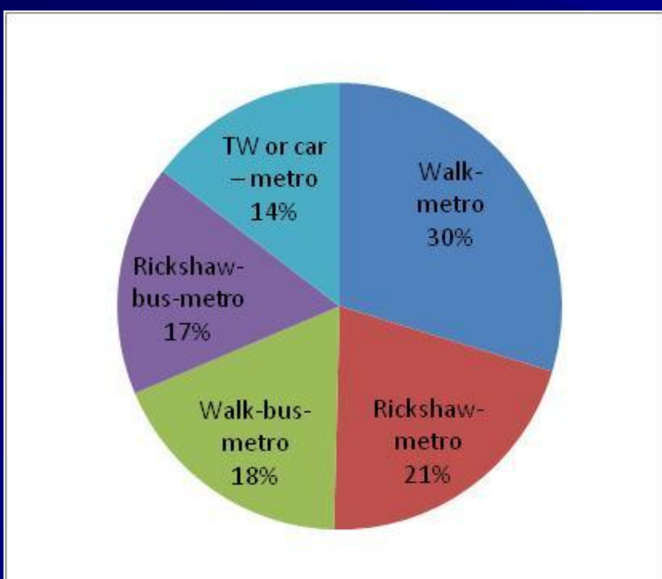
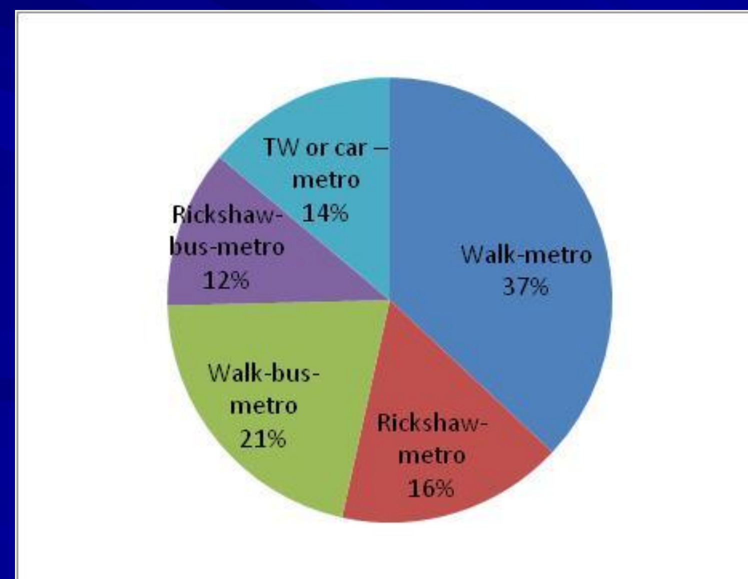
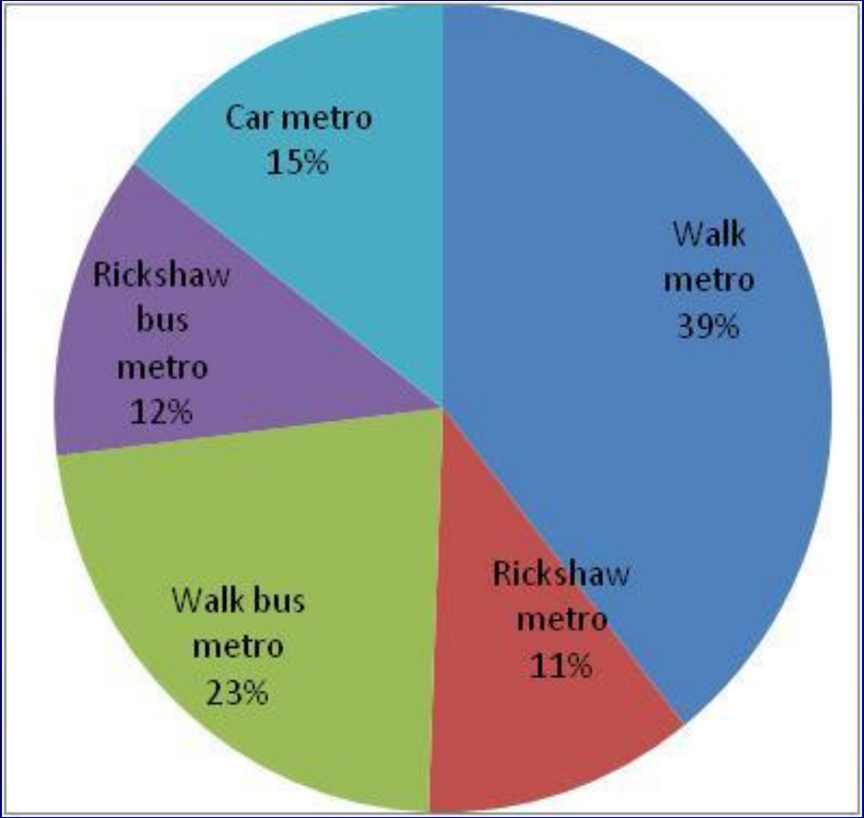


distribution of metro trips



Distribution of metro trips with complete metro line



Work done by Kartik Goel and Nikita Rathee (Ugs at IIT Delhi)

Conclusions

***Zoning methods*:**
more accurate results of short trip lengths and access and egress trips of public transport modes.

***Significance of access, egress trips*:**
affect the mode choice decision
their ratio with main line haul trip and total trip characteristics also significant

Trip projections for Metro:
trips projected by DMRC are at least 2-3 times more than the expected trips as projected by this study

Since the majority are short trips (less than10 km), a road based system provides better accessibility vis a vis metro system.

30 to 37% trips of the total trips by metro dependent on the rickshaw - restriction on rickshaws may have a negative impact on ridership of metro.

31 to 38% trips of metro dependent on the bus as a feeder mode - Rerouting of buses should be done carefully.

Thank You