Evaluating the importance of Trip chaining on travel behaviour

T E A M A

Ahana Sarkar (D2)

Neenu Thomas (D1)

Akash Dilip Yewale (M2)

Soham Satish Chintawar(M2)

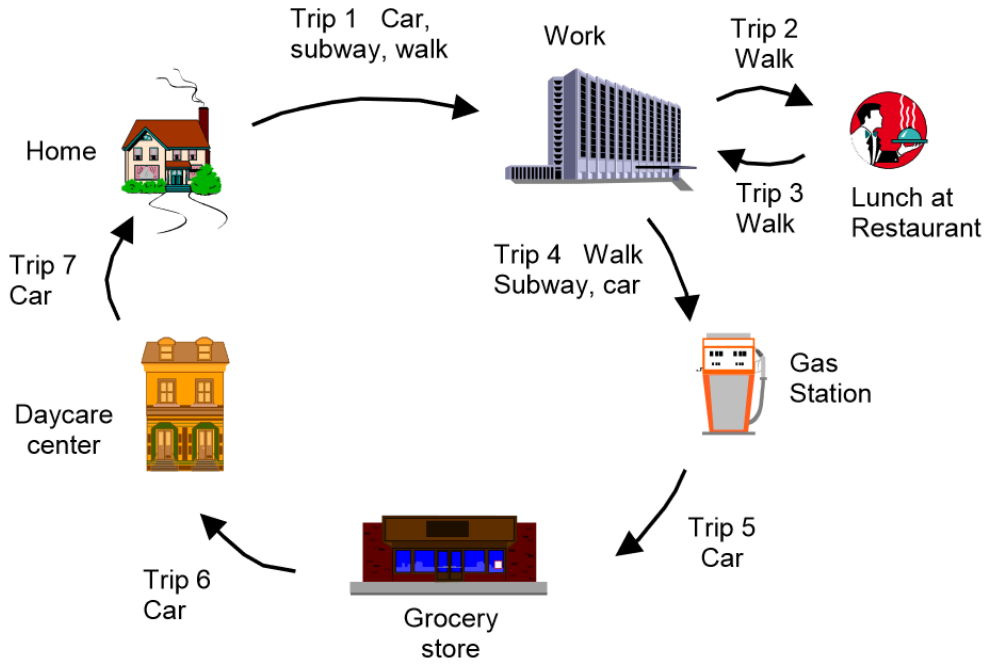
INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY

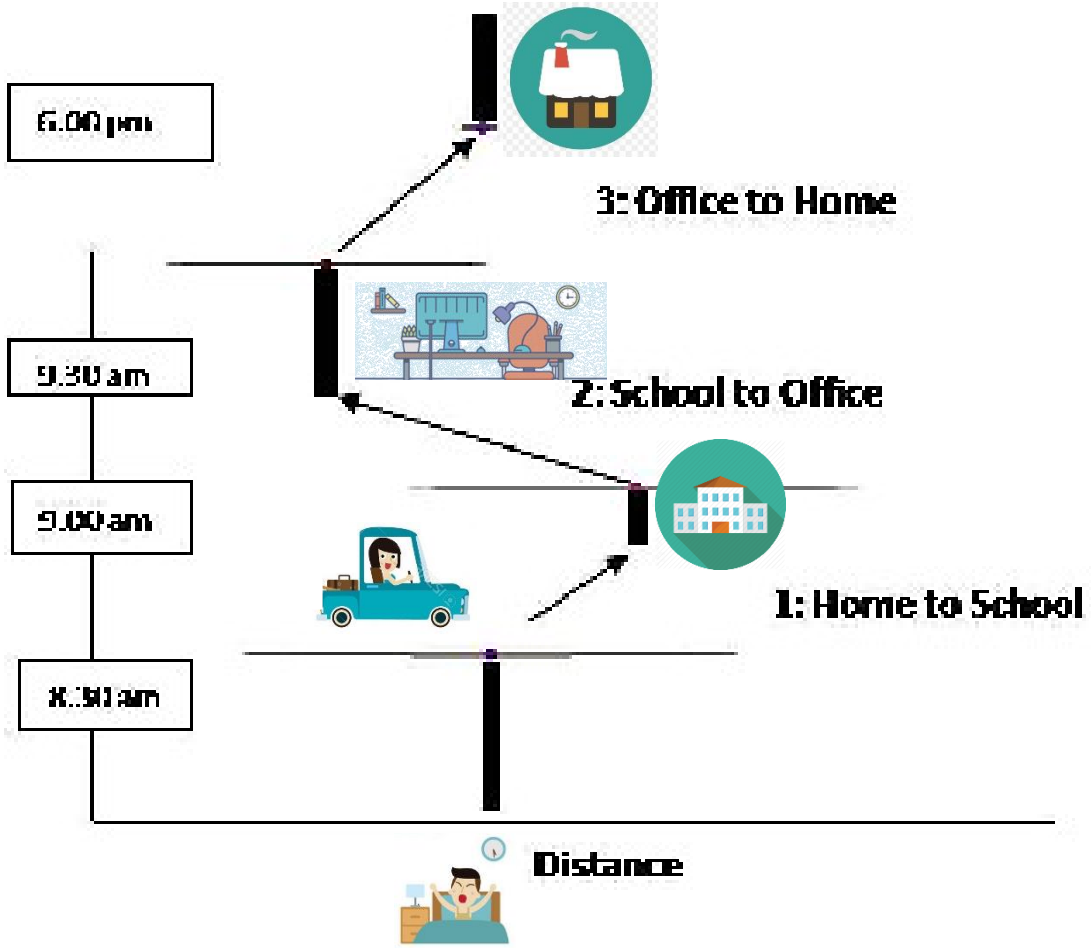
Background

Plan for the day ?

Plan: Single Trip/ Trip Chain/ Tour

Does mode choice change depending on individual decision of conducting Trip chain?





Time space prism showing trip

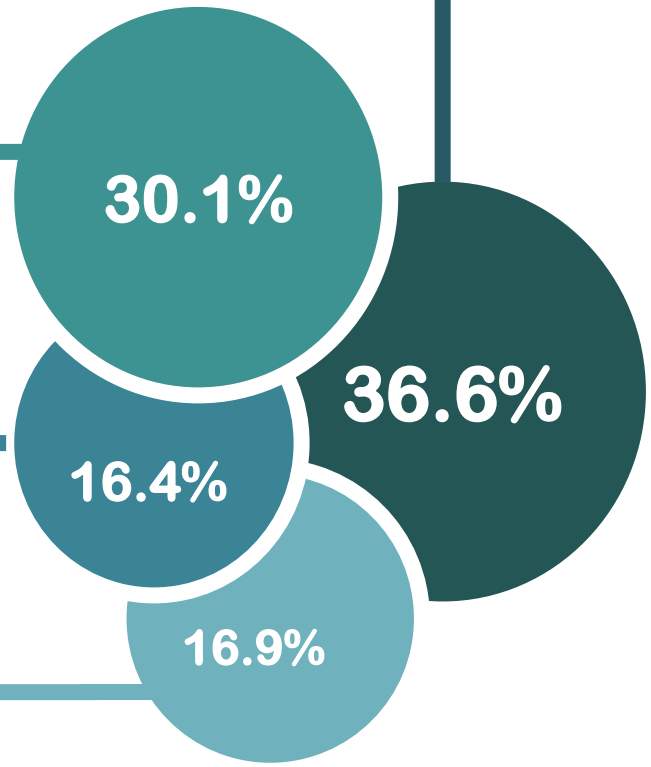
MODE CHOICE CONSIDERING TRIP CHAINING

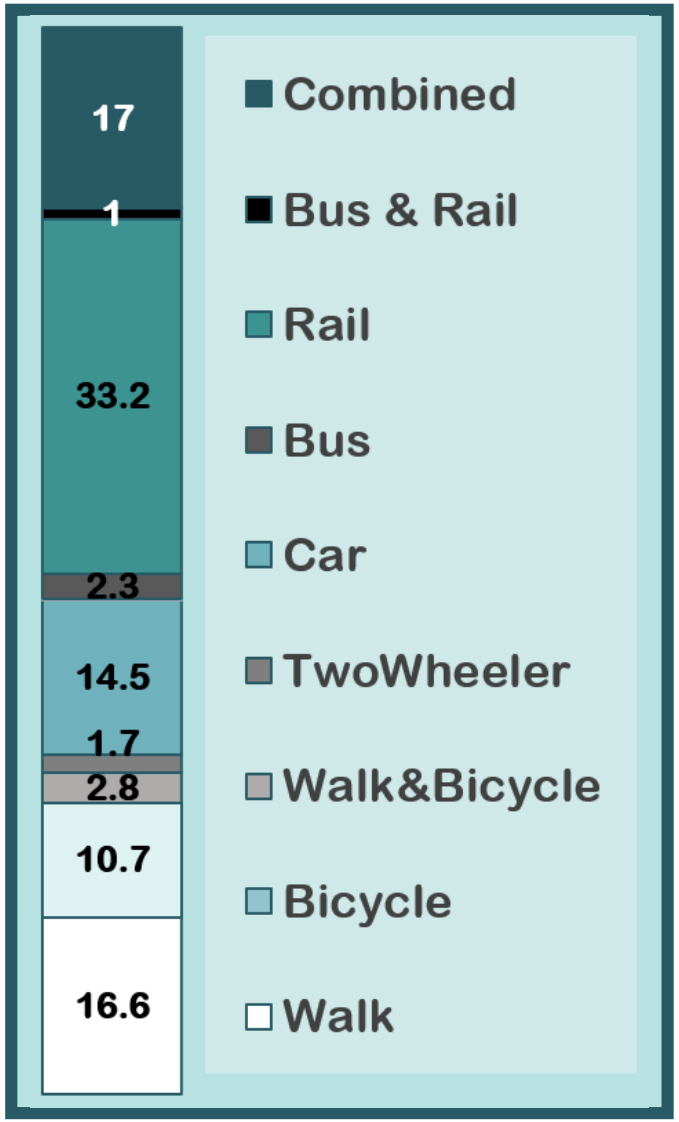
PUBLIC TRANSPORT
Bus
Rail
Bus and Rail

NON-MOTORISED
Walk
Bicycle
Walk and Bicycle

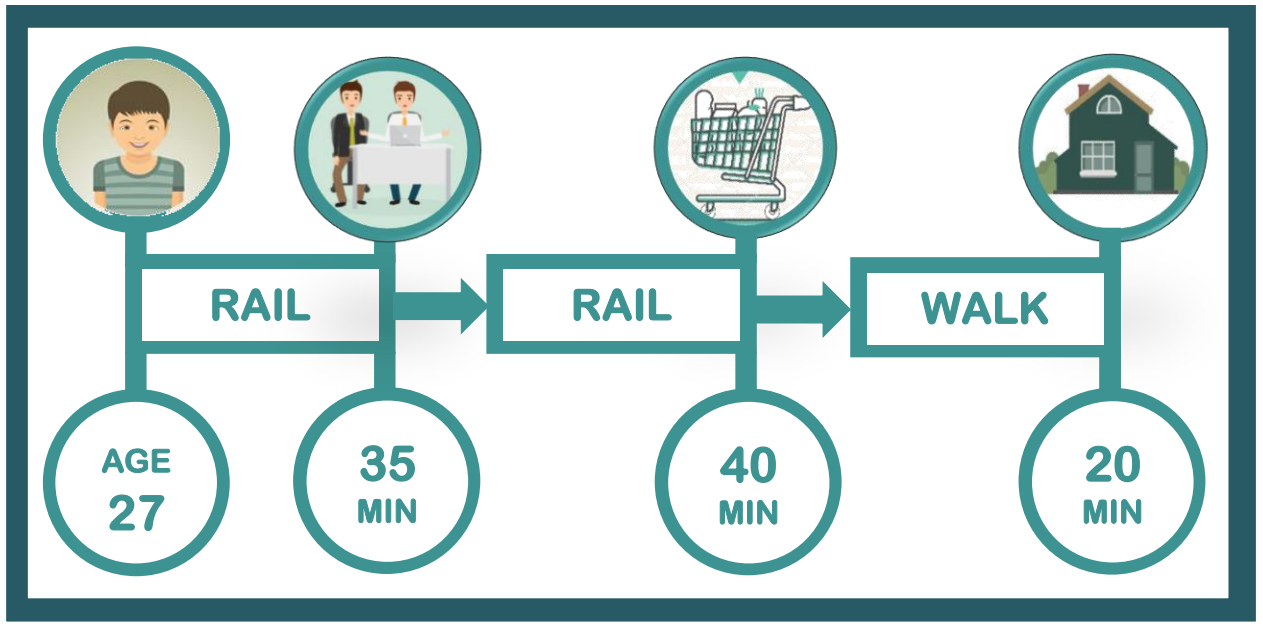
PRIVATE TRANSPORT
Two-wheeler
Car
Two-wheeler and Car

COMBINED
Combined

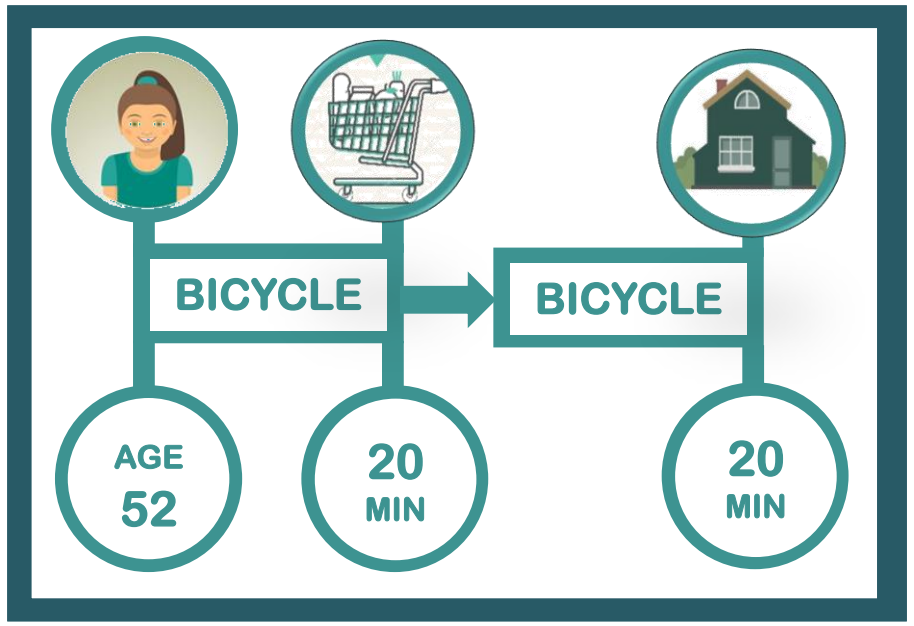




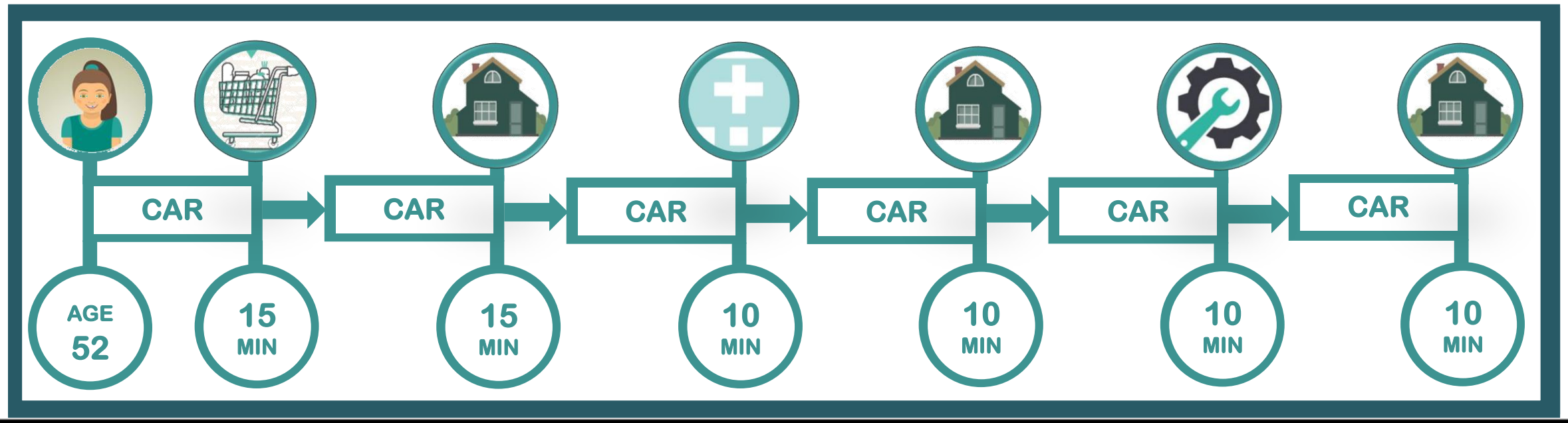
COMBINED MODE



NON-MOTORISED –BICYCLE ONLY



PRIVATE TRANSPORT– CAR ONLY



CONCEPTUAL FRAMEWORK

STEP 1

Mode Choice based on purpose
(PP CLEANED DATA)
1522 observations

Mode Choice → Rail, Bus, Car, Bicycle, Walk

Methodology
MNL

Variables	LL(0)	LL_final	Rho-square
Commute	-446.2	-173.9 (-362.2802 LL(C))	0.599
Work	-194.3	-99.4	0.462
Home	-734.3	-439.6	0.392
Leisure	-105.9	-6.205	0.365
Shopping	-285.2	-205.0	0.260

STEP 2

Mode Choice
(PT DATA)
1048575 observations

Mode Choice → Rail, Bus, Car, Bicycle, Bike, Walk

Methodology
MNL

Parameters	Values	Significant variable
LL(0)	-158475	Total Travel Time
LL_final	-886959.1	
Rho-Square	0.439	

STEP 3

- Individual data
- Trip data

Identification of parameters affecting TRAVEL TIME

Methodology: OLS

Travel time category

- <30MIN
- 30-90MIN
- 90-180MIN
- >180MIN

Variables	LL	Rho-suare
Trip	-612040	0.3426
Individual	-314640	0.3014

	Coefficients	Standard Error	t Stat
Intercept	1.671799	0.047066	35.52037
Male	-0.0674	0.010029	-6.72095
TripChainNo	-0.10139	0.006729	-15.0673
AgeMean	-0.00246	0.000349	-7.04979
TotalTravelTime	0.021093	7.05E-05	299.401
Work	1.91829	0.016538	115.9894
Commute	0.321115	0.023747	13.5223
Home	1.052165	0.040172	26.1912
Shopping	0.608598	0.016291	37.3579
Socialize	1.180927	0.017625	67.00468
Leisure	0.297226	0.030209	9.839046
Private	1.309722	0.01661	78.85297
Workrelated	0.055143	0.022668	2.432627

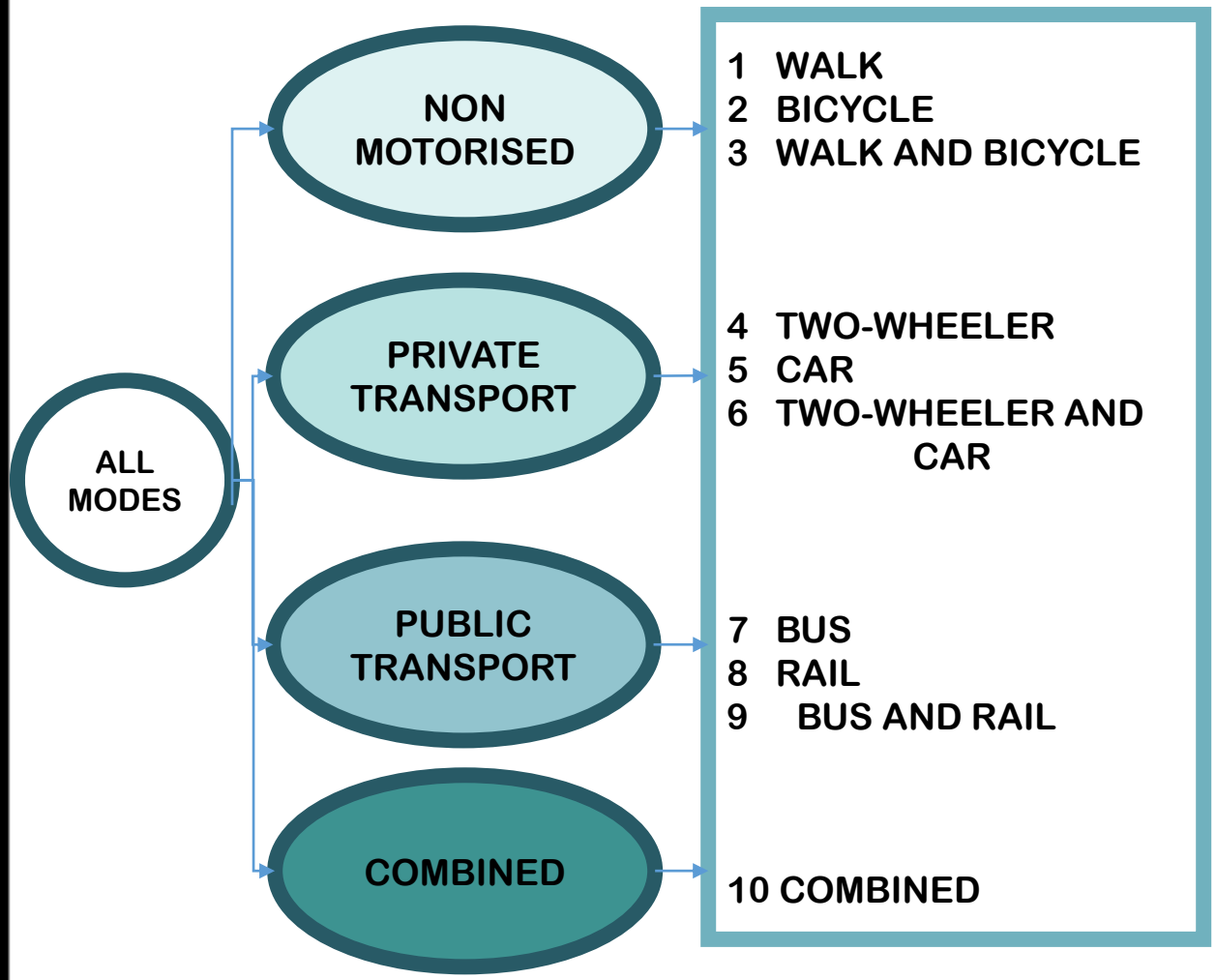
STEP 4

R square: 0.331

Significant Variables	30-90 minutes		90-180 minute		> 180 minute	
	Trip	Individual	Trip	Indivdual	Trip	Individual
	Male, Work, Commute	Work Related, Shopping, Rail	Age, Work, Commute	Work, Rail, Walk	Male, Work, Commute, Shopping, Socialize, Leisure, TwoWheeler, Bicycle, Walk	Work, Private, Rail, Bicycle, Walk

STEP 5

Mode Choice analysis for individual data which includes trip chaining



Variables	No o Obs.	L(0)	LL_Final	R-square
Multinomial Logistic Regression	3,21,339	-656,333.03	-444600	0.3226

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        Hausman-McFadden test

data:  f
chisq = 110.47, df = 26, p-value = 2.195e-12
alternative hypothesis: IIA is rejected
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Variables	No o Obs.	L(0)	LL_Final	R-square
Nested Logistic Regression	1,00,000	-175,05.72	-111310	0.364

Only individual specific variables

UNDERSTADING TRIP CHAINING SIGNIFICANCES

Variables	Two Wheeler Only			Car Only			Both Private (Two Wheeler and Car)		
	MNL	Nested Logit		MNL	Nested Logit		MNL	Nested Logit	
	Estimate	Estimate	Std. Er.	Estimate	Estimate	Std. Er.	Estimate	Estimate	Std. Er.
Intercept	-2.34***	-5.11***	0.683	-0.63***	-2.40***	0.472	-9.23***	-55.38***	2.409
Male	1.22***	1.51***	0.186	0.52***	0.69***	0.098	1.28***	5.98***	1.130
Age	-0.023***	0.003	0.005	-0.005***	-0.02***	0.003	-0.026***	-0.07***	0.017
Trip Chain Number	-0.16***	-1.09***	0.181	-0.18***	-0.06	0.070	0.39***	2.64***	0.120
Total Travel Time	0.019***	-0.009**	0.003	0.039***	0.153***	0.001	0.041***	0.14***	0.002
Work	1.208***	1.96***	0.347	0.223***	0.28***	0.176	1.373***	4.85	0.817
Work Related	0.897***	-0.00	0.515	1.248***	2.74***	0.299	2.653***	18.30***	1.392
Commute	-3.049***	-2.07***	0.520	-2.963***	-6.05***	0.270	-3.044***	-11.98*	5.461
Home	0.329*	0.38	0.512	-0.480***	-1.40***	0.397	0.578	3.24**	1.251
Shopping	-0.489***	-0.94**	0.356	-0.353***	0.11	0.165	0.416***	3.84***	0.581
Socialize	-0.825***	0.12	0.387	-0.653***	-0.44*	0.175	-0.045	1.20.	0.631
Leisure	0.412***	-0.87	0.746	0.276***	2.64***	0.355	0.873***	-0.50	3.047
Private	-0.094***	0.60	0.367	0.013***	1.58***	0.165	1.081***	4.83***	0.736

Trip chaining is less with use of Two-wheeler Only

- Reference mode : Walk
- Note: ***, **, * = significance at 1%, 5%, 10% levels

NEST: PRIVATE TRANSPORT

Variables	Bus Only			Rail Only			Both public (Rail and Bus)		
	MNL	Nested Logit		MNL	Nested Logit		MNL	Nested Logit	
	Estimate	Estimate	Std. Er.	Estimate	Estimate	Std. Er.	Estimate	Estimate	Std. Er.
Intercept	-2.50***	-13.65***	1.220	-0.61***	0.43	0.452	-8.23***	-42.36***	1.425
Male	-0.50***	-0.59**	0.209	-0.09***	-0.03	0.082	-5.22***	-0.93**	0.306
Age	0.020***	0.08***	0.007	-0.015***	-0.04***	0.003	0.009***	0.05***	0.010
Trip Chain Number	-1.63***	-4.55***	0.371	-1.88***	-1.07***	0.072	-1.06***	0.84***	0.190
Total Travel Time	0.046***	0.11***	0.002	0.059***	0.15***	0.001	0.055***	0.15***	0.002
Work	0.620***	-6.37***	0.594	2.066***	2.84***	0.172	2.589***	3.64***	0.448
Work Related	2.653***	-2.32**	0.901	1.569***	2.81***	0.291	2.532***	9.47***	0.509
Commute	-0.879***	-5.66***	0.777	-0.663***	-3.64***	0.224	0.567***	1.23	0.773
Home	0.940***	2.74**	1.050	1.478***	-0.21	0.387	1.377***	0.39	0.958
Shopping	-0.015	3.81***	0.517	-0.138***	-1.02***	0.158	2.124***	10.75***	0.432
Socialize	-0.419***	2.33***	0.534	0.129***	-0.48**	0.165	1.602***	6.73***	0.396
Leisure	-1.004***	4.20***	0.724	-0.968***	1.02**	0.359	1.266***	8.41***	0.571
Private	0.540***	2.36***	0.516	0.844***	1.49***	0.154	2.409***	9.04***	0.413

Trip chaining is with use of Rail Only and Bus Only

MODEL	MNL	NESTING
Number of observations	3,21,339	1,00,000
Log- Likelihood	-385390	-111310
McFadden's value (R sq)	0.334	0.364
Likelihood ratio	386660	127740

NEST: PUBLIC TRANSPORT

Variables	Bicycle Only			Both Non-motorised (Walk and Bicycle)			Combined Group		
	MNL	Nested Logit		MNL	Nested Logit		MNL	Nested Logit	
	Estimate	Estimate	Std. Er.	Estimate	Estimate	Std. Er.	Estimate	Estimate	Std. Er.
Intercept	-0.68***	-5.26***	0.726	-7.40***	-33.22***	1.098	-5.04***	-4.11***	0.447
Male	0.02	0.21.	0.129	0.18***	0.07	0.178	0.005	0.12	0.081
Age	-0.009***	-0.03***	0.004	-0.009***	-0.02***	0.007	-0.007***	-0.02***	0.003
Trip Chain Number	-0.03**	0.26**	0.097	0.79***	2.70***	0.075	0.16***	0.60***	0.064
Total Travel Time	0.006***	0.14***	0.002	0.007***	0.11***	0.003	0.046***	0.14***	0.001
Work	1.027***	1.26***	0.242	1.310***	3.108***	0.272	1.833***	2.52***	0.156
Work Related	0.766***	2.02***	0.410	0.948***	5.69***	0.404	1.675***	3.30***	0.281
Commute	-1.492***	-10.12***	0.391	1.244***	5.28***	0.427	-0.061	-3.19***	0.211
Home	0.496***	-0.77	0.622	1.104***	0.12	0.888	0.090	-1.08***	0.385
Shopping	0.243***	0.40.	0.218	0.793***	4.25***	0.237	1.226***	1.61***	0.143
Socialize	-0.067*	-0.53*	0.241	1.130***	5.32***	0.240	1.223***	1.45***	0.152
Leisure	0.308***	2.50***	0.480	1.227***	5.43***	0.495	1.104***	3.09***	0.337
Private	0.325	1.63***	0.219	1.452	8.27***	0.261	1.631***	2.93***	0.142

Trip chaining is more when there is use of Bicycle

Except for Bicycle, Trip chaining is less when the use of single mode is involved

Trip chaining is more when there is use of combination within nest and combined group

STEP 6

IMPACT OF TRIP CHAINING ON COMBINED MODES

MDCEV MODEL

Only refined data is taken that involves combined modes which will help to understand Multiple discrete mode choices

Variables	Bicycle	Two-Wheeler	Car	Bus	Rail
B coefficient	-3.659***	-4.907***	-1.316***	-2.571***	-1.604***
Male	-0.080*	0.739***	0.183***	-0.320***	-0.123***
Trip Chain Number	-0.192***	0.147***	0.103***	-0.288***	-0.307***
Age	0.002*	0.008***	-0.002***	0.025***	0.001
Work	0.007***	0.022***	0.001*	-0.015***	0.011***
Work Related	0.026***	0.037***	0.032***	0.007***	0.014***
Commute	0.028***	0.022***	0.015***	0.011***	0.012***
Home	0.011***	0.025***	0.012***	0.003**	0.004***
Shopping	-0.0009	0.0006	-0.019***	-0.007***	-0.0006
Socialize	-0.006***	0.003	-0.006***	-0.011***	-0.0009
Leisure	0.004*	0.010*	0.009***	0.006***	-0.0002

Satiation Parameter

Mode Choice	Satiation Parameter
Walk	0.320***
Bicycle	0.695***
Two-wheeler	0.860***
Car	0.789***
Bus	0.913***
Rail	0.958***

No. of observations: 47803
Log Likelihood: -293305.2

People who want to do trip chaining prefer two-wheeler and car (private transport).

SUMMARY AND SUGGESTION

FINDINGS

People prefer less trip chaining when they prefer single type of motorised mode for their trips in a day

Trip chaining is increasing when there are combinations of modes

For combined groups, people do more trip chaining with two-wheeler and car (private transport).

People tend to use less public transport when they are involved with multiple trip chaining.

SUGGESTION

For Public transport
Better last mile connectivity needed.

Increase of accessibility of public transport (buses)

Parking
Provision of enough parking spaces for private vehicles in shopping areas and offices

In contrary, to reduce private transport use, we can increase parking prices.