Assessment of Transportation Geography in Tokyo

Group-3

Team Members

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Elements of Transport Geography

- Socio economic variables
- Inter and Intra Regional travel behaviour
- Time space mapping for various trips

Research Objective & Methodology

To assess the

“Travel Behaviour”

for **varied geography**

Objective

Travel Behavior assessment at Tokyo

Mode choice using: Classification based machine learning methods

Travel Behavior assessment at Koto city level (Inter regional level)

Various trip purposes using:
Activity based time use model

Travel Behavior assessment at Toyusu (Intra region level)

Socio-economic variables: Cluster analysis and Space Time Cube Creation

Results

Conclusion

Travel Behavior assessment at Tokyo level

Description of PT data

 **48.07%**  **51.93%**

Age

0-29 : 23.4% **30-39 :** 18.3% **40-49:** 17.4%

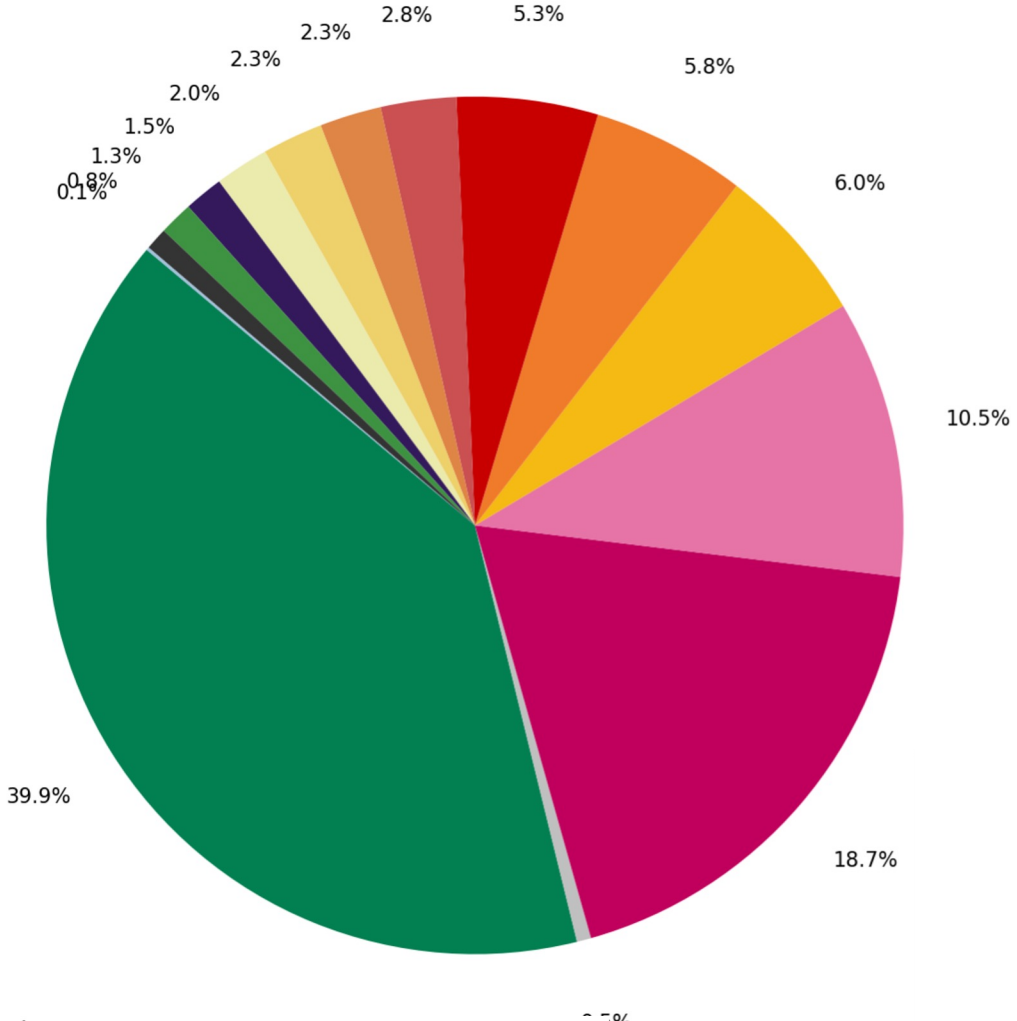
50-59: 40.9% **>60:** 26%

Mode Choice

 **22.4%**  **3.5%**

 **32.5%**  **15.4%**

 **1.9%**  **23.9%**



PT Data Analysis

For mode choice : Classification based machine learning models

Evaluation Metrics	Definition	Average / Total		
		Boosting	Random Forest	Decision Tree
Accuracy	Fraction of correct predictions	0.818	0.827	0.816
Precision (Positive Predictive Value)	Proportion of examples that are correctly identified as relevant to the classification is known as the precision (or positive predictive value).	0.400	0.451	0.376
Recall (True Positive Rate)	Proportion of Positive samples that were correctly identified as Positive to all Positive samples.	0.455	0.480	0.449
False Positive Rate	Measure of the proportion of negative cases in the data that were incorrectly reported as positive.	0.127	0.120	0.131
F1 Score	Weighted average of Precision and Recall	0.393	0.441	0.363
Area Under Curve (AUC)	Measure of a classifier's ability to distinguish between classes	0.704	0.603	0.554
Negative Predictive Value	Percentage of predicted negatives that are true negatives	0.883	0.887	0.884
True Negative Rate/Specificity	Proportion of samples that are genuinely negative and produce a negative result	0.873	0.880	0.869
False Negative Rate	Proportion of all negatives that still result in positive test results	0.728	0.701	0.740

PT Data Analysis

Exploration of Random forest model

- Mean Decrease in Gini - **Age** and **Sex** are the most important predictors
- a positive impact on model accuracy
- StayTime and Purpose, have relatively lower importance.

Confusion Matrix

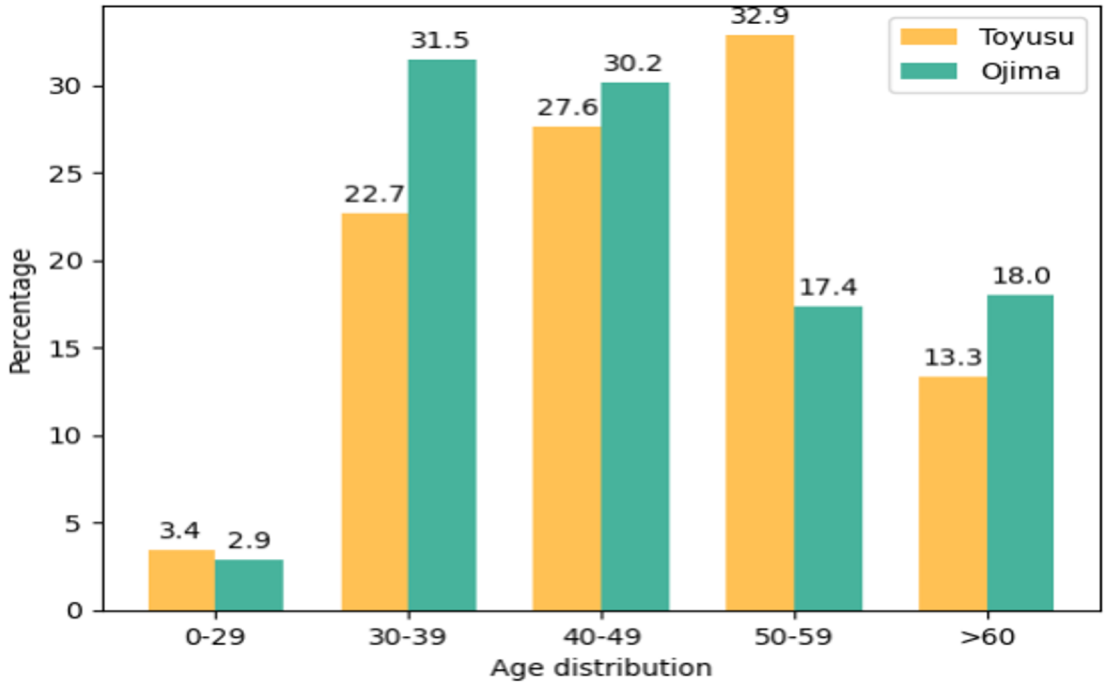
		Predicted					
	Mode	**bicycle**	**bus**	**car**	**railway**	**two-wheeled vehicle**	**walk**
Observed	bicycle	0.02	0	0.02	0.06	0	0.05
	bus	0	0	0	0.01	0	0.01
	car	0.02	0	0.07	0.09	0	0.05
	railway	0.01	0	0.03	0.25	0	0.04
	two-wheeled vehicle	0	0	0	0.01	0	0
	walk	0.02	0	0.03	0.06	0	0.13

Variable Importance	**Mean decrease in accuracy**
Sex	0.048
Age	0.042
Purpose	-0.017
StayTime	-0.002

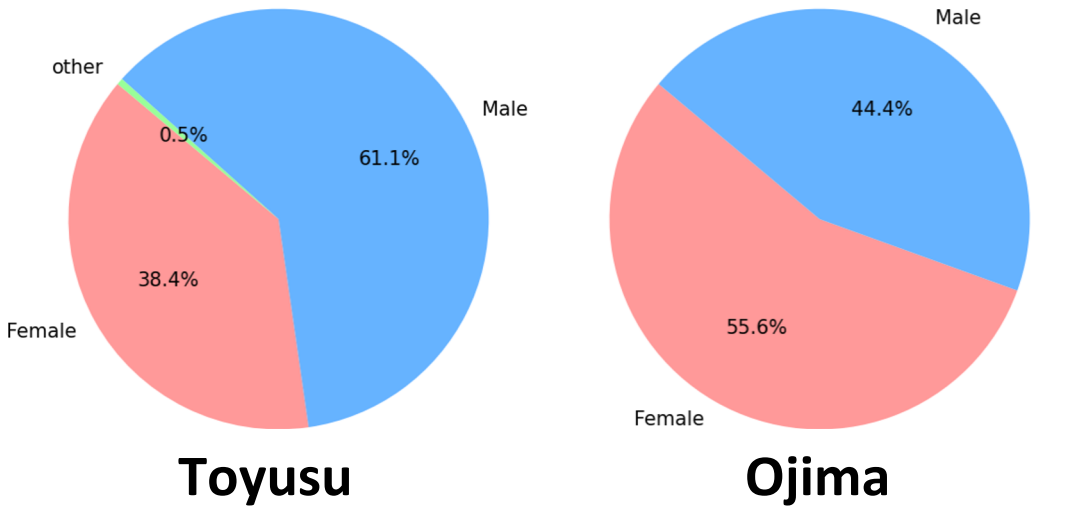
Travel Behavior assessment at Koto city level (inter regional level)

Description of PP data

Age Distribution

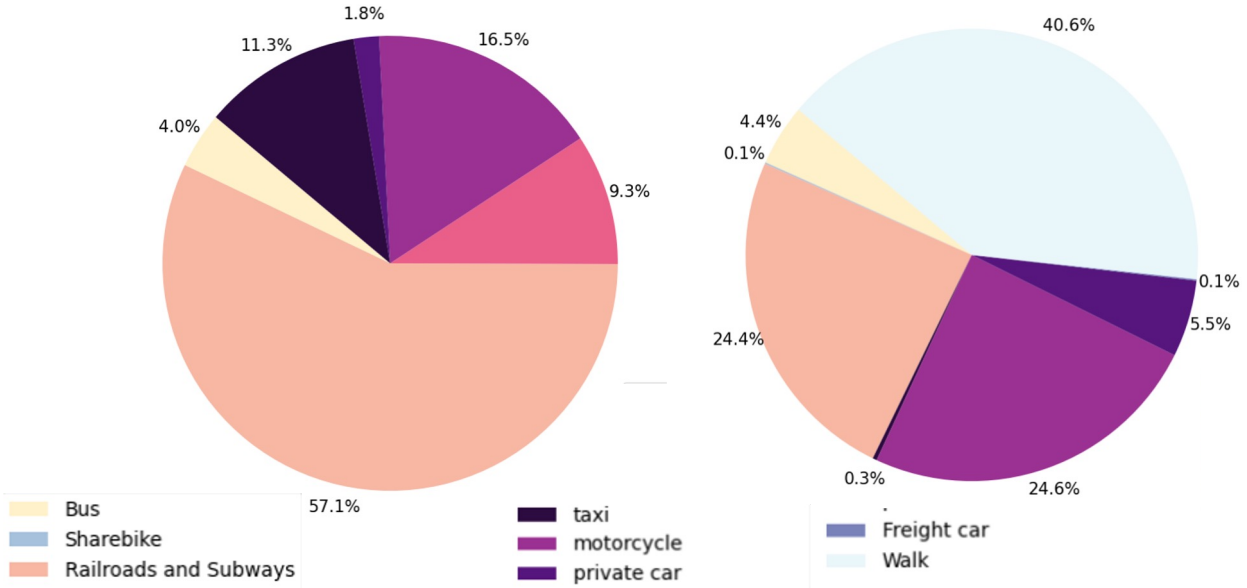


Gender Distribution



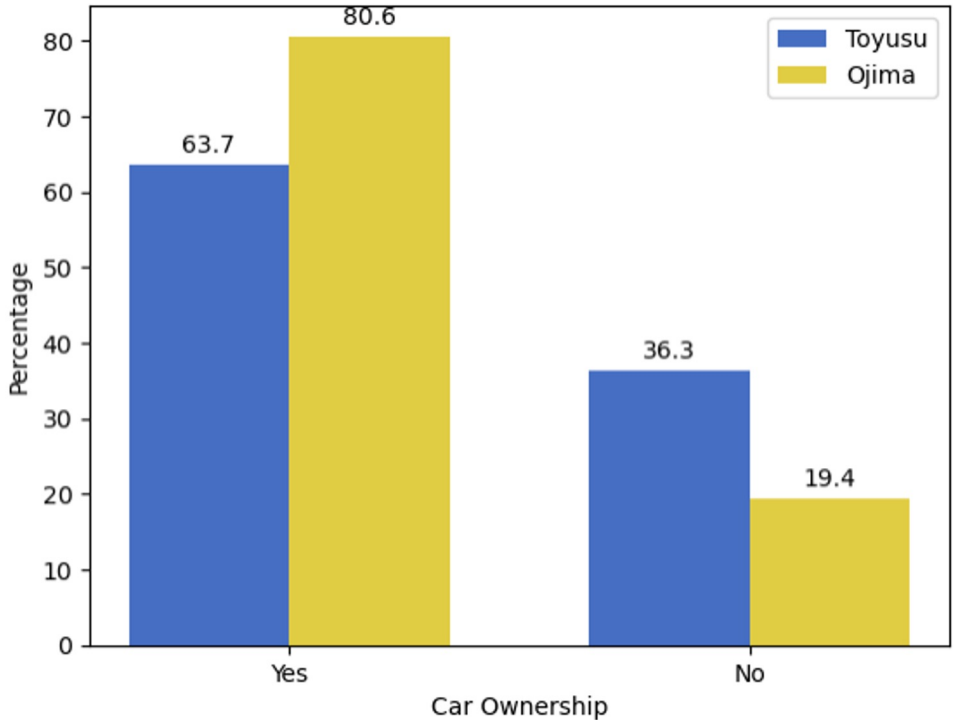
Toyusu **Ojima**

Mode Choice

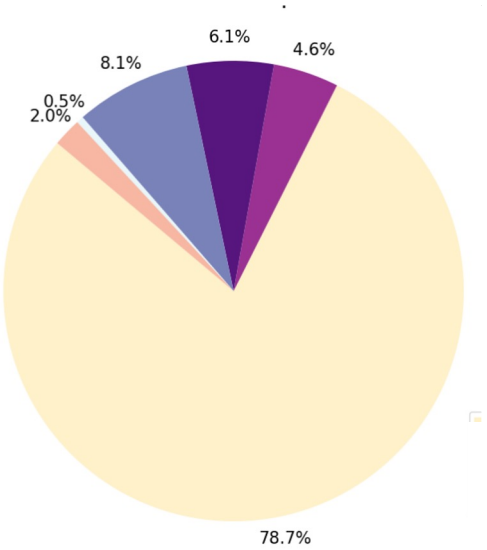


Description of PP data

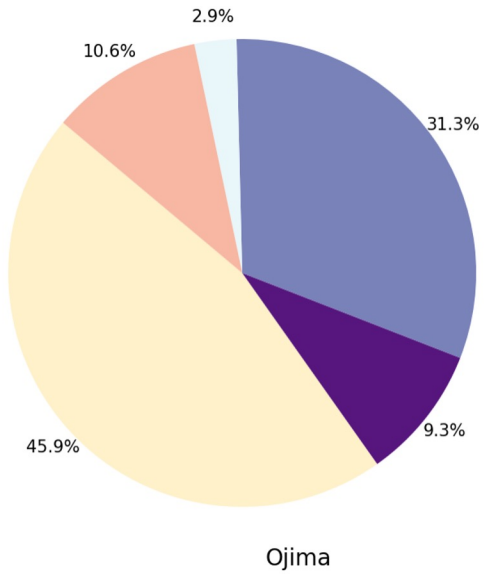
Car Ownership



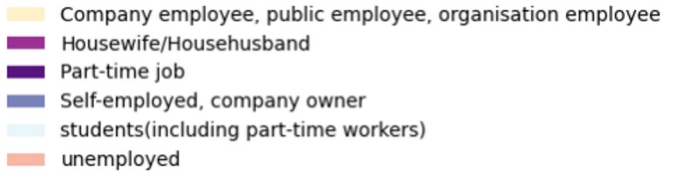
Occupation



Toyusu



Ojima



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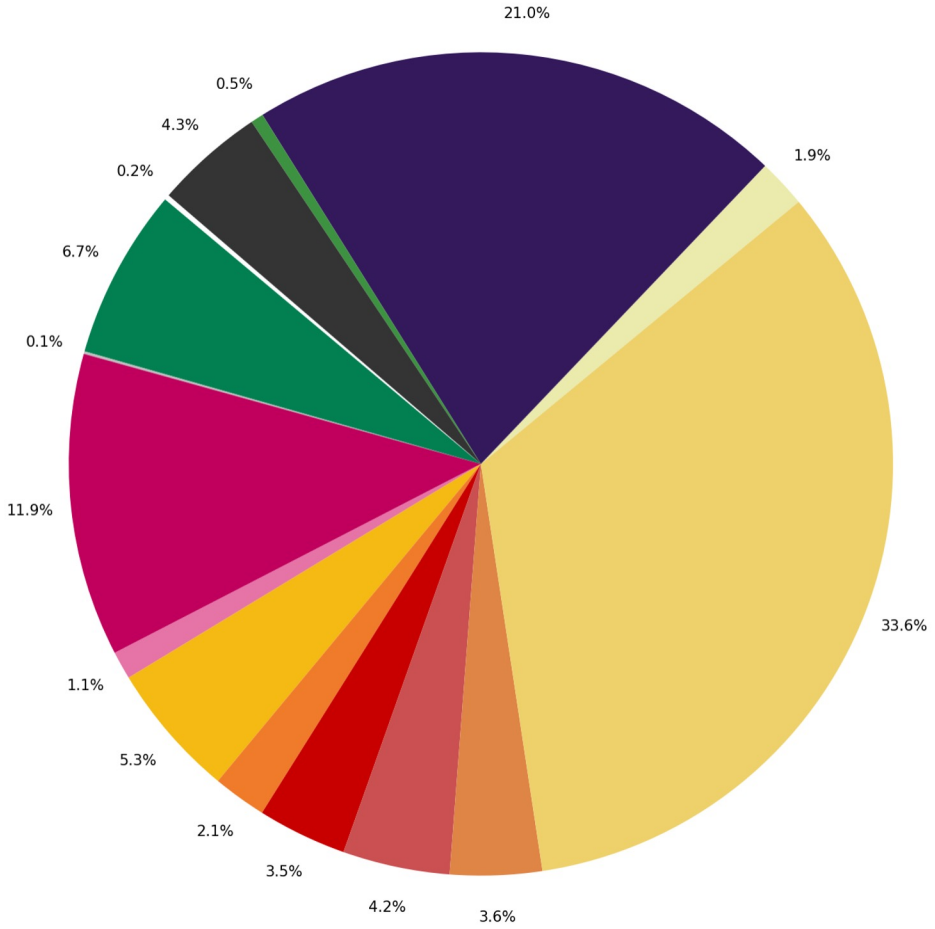
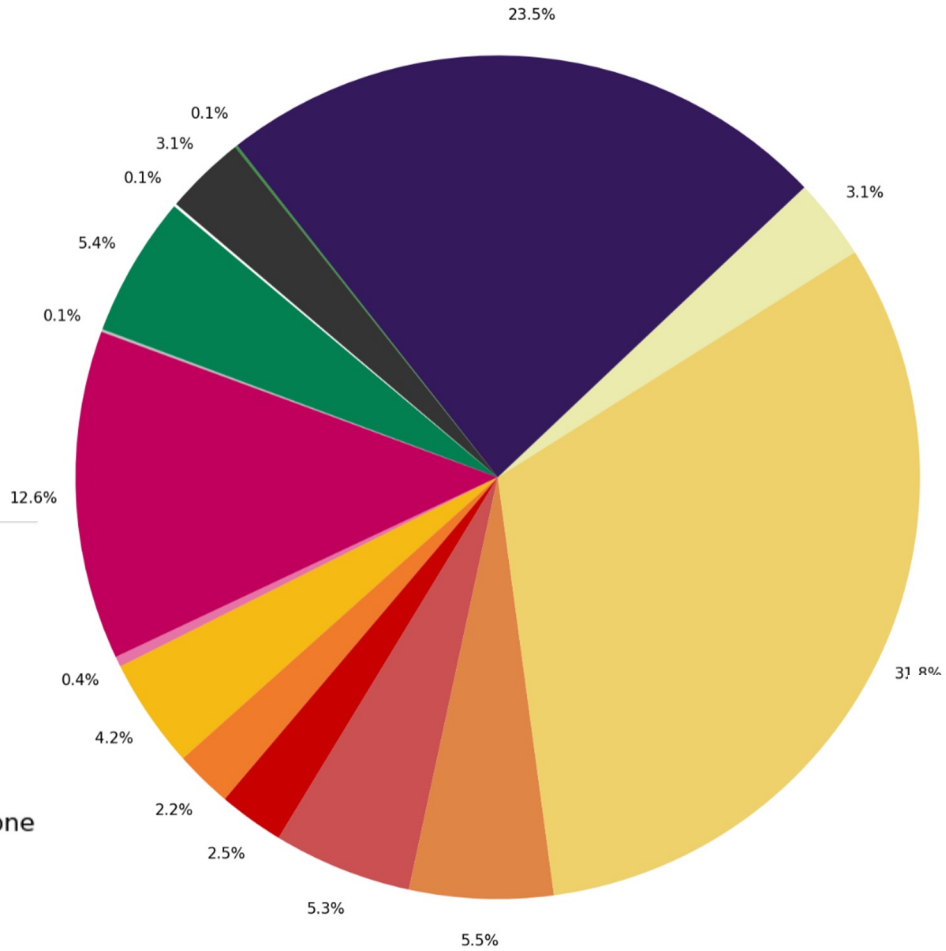


Toyusu

Purpose of Trip

- Business trips
- Unknown
- Commuting to work or school
- Going out for a lesson
- Going out to eat
- Going to hospital
- Leisure
- Other
- Picking up or seeing off someone
- Returning home
- Returning to work or school
- Shopping
- Sightseeing
- Strolling
- Waiting time



Ojima

Activity based time use model

Negative coefficient for **work trip** and **business** trip for **women**

Fractional Multinominal Logit Model for various trips

	Ojima		Toyusu	
Variables	**Estimate**	**Rob.t-ratio(0)**	**Estimate**	**Rob.t-ratio(0)**
asc_Business_trip	4.03	3.77	5.06	13.85
asc_work_trip	5.08	5.61	5.11	19.76
asc_lesson_trip	2.20	2.02	2.80	10.49
asc_eat_trip	4.17	5.08	4.41	21.35
asc_hospital_trip	3.35	3.89	3.49	16.29
asc_Leisure_trip	3.68	4.16	4.07	18.97
asc_Other_trip	4.19	5.24	4.20	20.08
asc_Picking_up_trip	3.99	4.41	3.73	15.03
asc_Returning_home_trip	6.04	7.66	6.26	31.97
asc_Returning_to_work_trip	3.62	4.24	3.16	12.17
asc_Shopping_trip	5.55	6.80	5.50	26.93
asc_Sightseeing_trip	1.46	1.35	2.42	9.25
asc_Waiting_time	-5.16	-4.11	1.34	3.11
asc_Strolling_trip	3.86	4.65	4.49	19.15
asc_Unknown_trip	1.00	NA	1.00	NA
Business_trip_female	**-0.27**	**-1.76**	**-0.95**	**-3.50**
work_trip_female	**-0.02**	**-1.55**	**-0.25**	**-2.01**
Shopping_trip_female	**0.03**	**1.10**	**0.14**	**1.70**
Waiting_time_female	4.51	3.24	-0.60	-0.91
Business_trip_Age_upto_39	-0.06	-0.08	-0.46	-1.08
work_trip_Age_upto_39	0.16	0.30	0.53	2.41
Business_trip_Age_40_59	0.88	1.20	-0.29	-0.78
work_trip_Age_40_59	0.32	0.72	0.40	2.00
Strolling_trip_Age_above_60	0.91	2.06	-0.24	-0.61
AIC	2565.85		63015.73	
BIC	2667.51		63191.46	
LL(start)	-1732.93		-43762.72	
LL(final)	-1259.93		-31484.86	

Transferability of Activity based time use model

Transferable except

waiting time and business trip for female

Variables	θi	θj	(θ/τi)^2	(θ/τj)^2	sqrt[(θ/τi)^2 + (θ/τj)^2]	t_star
asc_Business_trip	-0.98	1.67	0.77	1.71	1.57	-1.68
asc_work_trip	4.30	4.82	0.05	0.70	0.86	-0.60
asc_lesson_trip	2.32	2.48	0.11	1.43	1.24	-0.13
asc_eat_trip	2.80	2.20	0.07	1.18	1.12	0.54
asc_hospital_trip	4.41	4.17	0.04	0.68	0.85	0.29
asc_Leisure_trip	3.49	3.35	0.05	0.75	0.89	0.15
asc_Other_trip	4.07	3.68	0.05	0.78	0.91	0.43
asc_Picking_up_trip	4.20	4.19	0.04	0.64	0.83	0.01
asc_Returning_home_trip	3.73	3.99	0.06	0.82	0.94	-0.28
asc_Returning_to_work_trip	6.26	6.04	0.04	0.62	0.81	0.28
asc_Shopping_trip	3.16	3.62	0.07	0.73	0.89	-0.52
asc_Sightseeing_trip	2.42	1.46	0.07	1.17	1.11	0.86
asc_Waiting_time	1.34	-5.30	0.19	1.89	1.44	4.60
asc_Strolling_trip	4.49	3.86	0.05	0.69	0.86	0.73
asc_Unknown_trip	NA	NA	NA	NA	NA	NA
Business_trip_female	8.20	3.72	0.88	0.88	1.33	3.38
work_trip_female	4.01	3.67	0.07	0.77	0.91	0.38
Shopping_trip_female	2.13	1.36	0.02	0.40	0.65	1.19
Waiting_time_female	-1.36	-0.46	0.10	0.21	0.55	-1.62
Business_trip_Age_upto_39	-0.40	0.06	0.02	0.09	0.33	-1.37
work_trip_Age_upto_39	0.15	0.05	0.01	0.07	0.28	0.35
Business_trip_Age_40_59	-0.60	4.66	0.43	2.24	1.63	-3.22
work_trip_Age_40_59	0.28	0.08	0.08	0.57	0.81	0.25
Strolling_trip_Age_above_60	0.90	0.51	0.03	0.26	0.54	0.73

Note : reject null hypothesis when (t_star < 1.96)

Travel Behavior assessment at Toyusu (Intra region level)

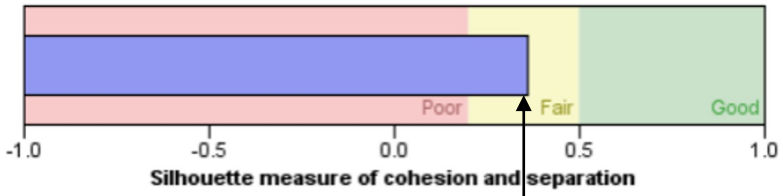
Cluster analysis

- Socio-economic variables
- Travel characteristics

Model Summary

Algorithm	TwoStep
Inputs	7
Clusters	2

Cluster Quality

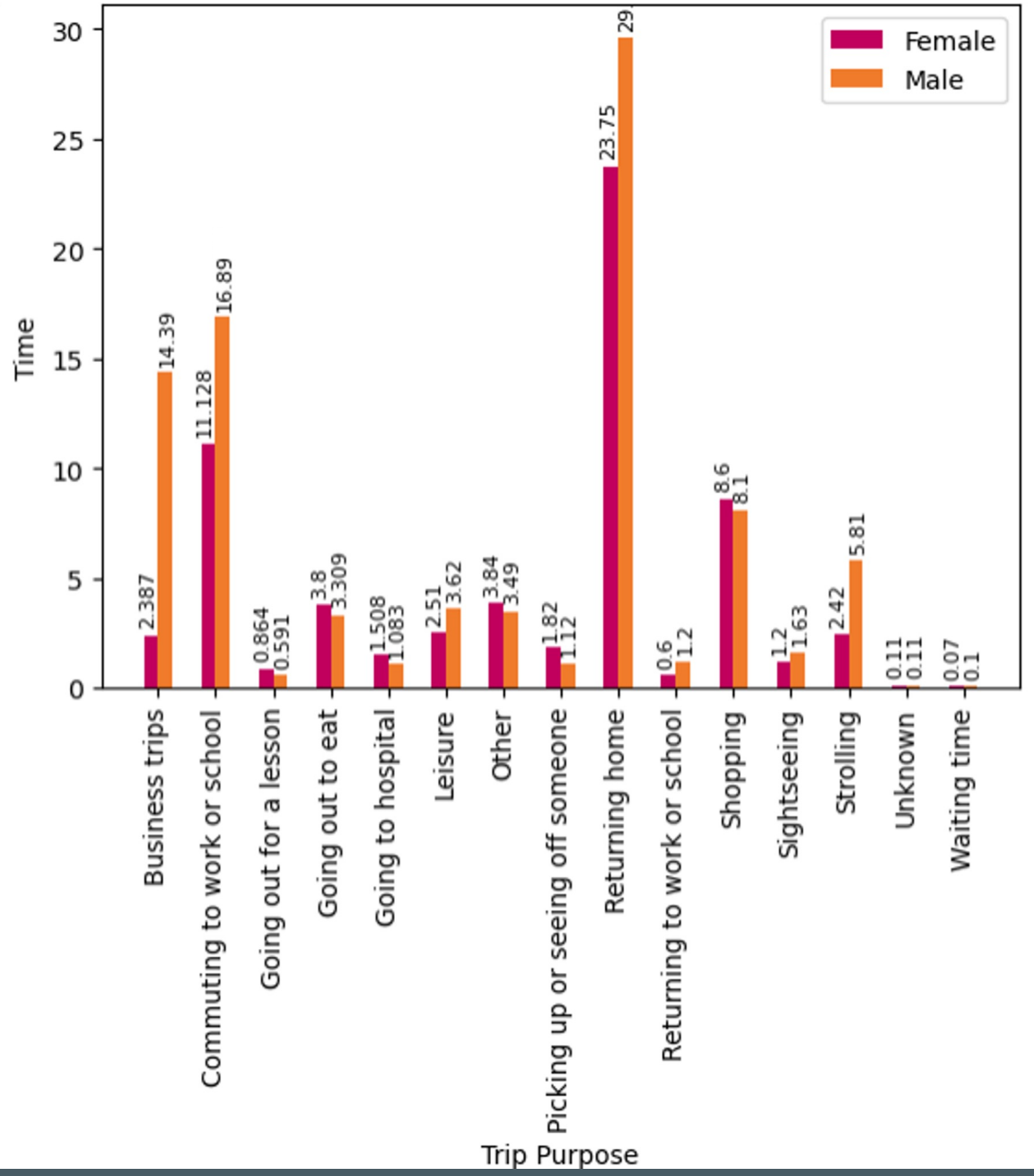


0.36 - Good fit

Variables	Cluster 1	Cluster 2
Size	25138 (74.1%)	8801 (25.9%)
Most Frequent Age	40-49 (28.3%)	50-59 (66.8%)
Car Ownership	No (85.8%)	Yes (99.3%)
Most Frequent Income level	2,000,000 yen to 5,990,000 (37.2%)	10,000,000 to 14,990,000 (40%)
Most frequent mode of transport	Walk (41.7%)	Car (31.1%)
Most frequent occupation	Company, public employee (71.6%); Self-employed (12.3%); and housewife/househusband (7.7%)	Company, public employee (98.8%)
Gender	Female (51.3%)	Male (96.4%)
Most frequent trip purpose (excluding return home)	Shopping (24.8%); Commute to work (11.5%); Picking up someone (2.7%)	Shopping (17%); Commute to work (15.3%); Picking up someone (4.5%)

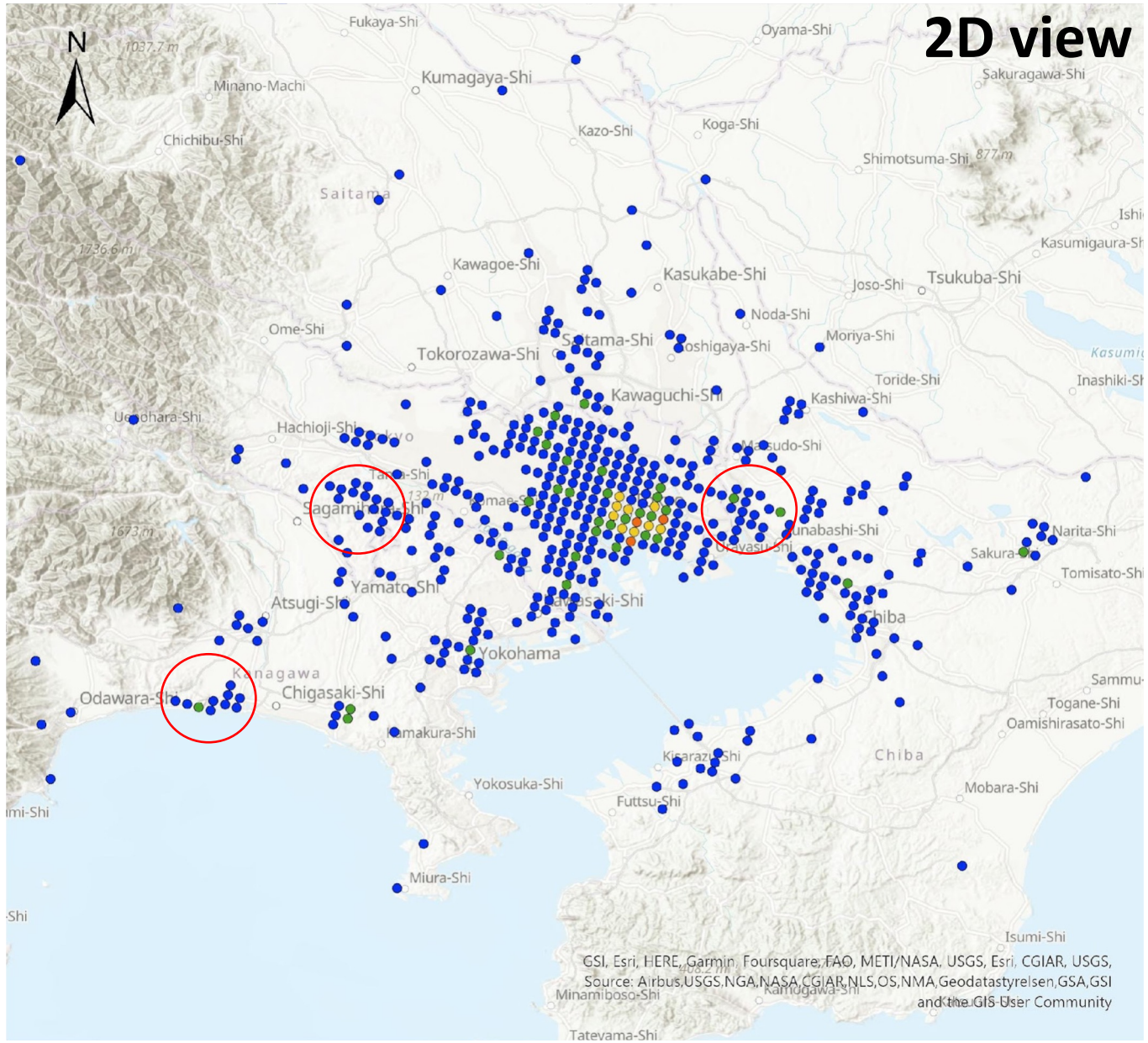
Gender wise travel duration

- Time spent for work trips and business trips are more for male
- Time spent for shopping trip and pick up trips are more for female



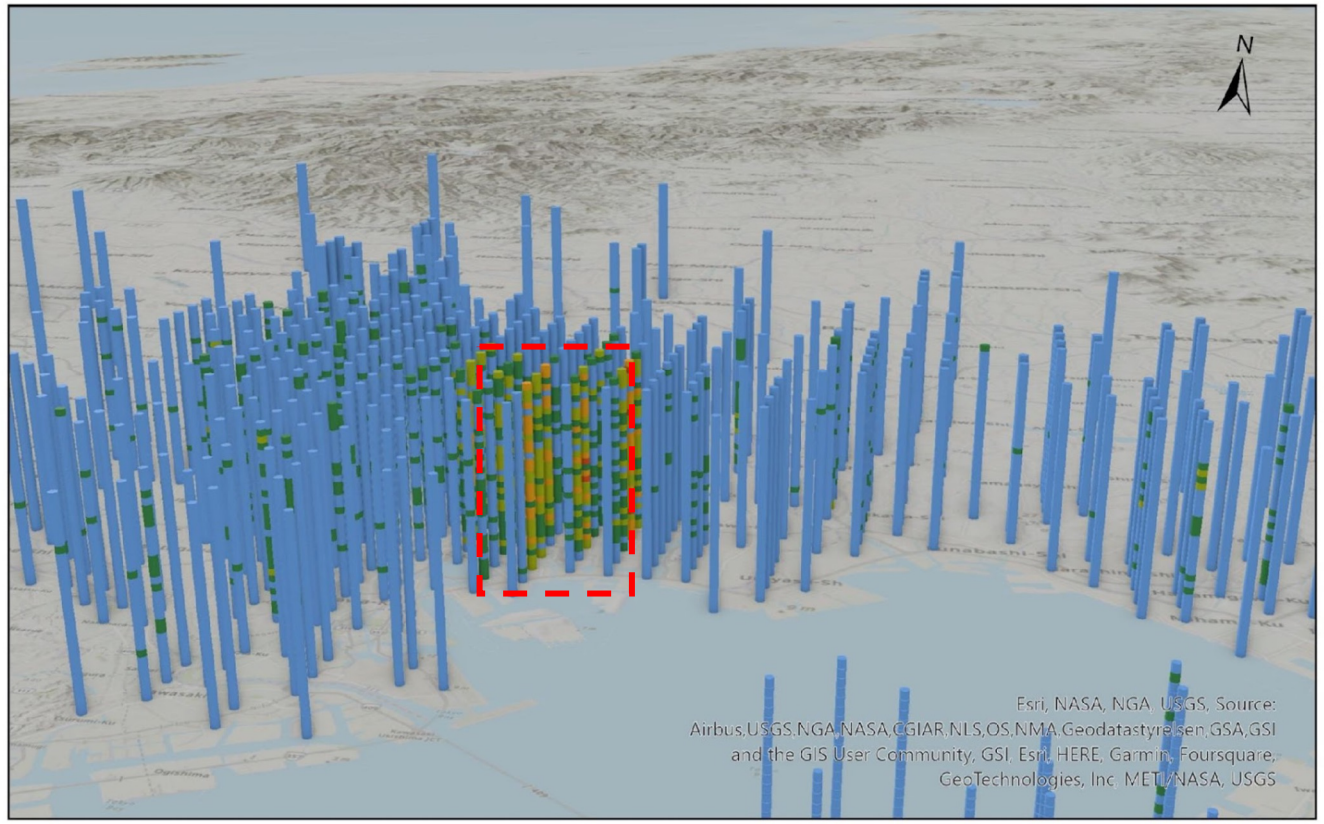
Space Time Cube

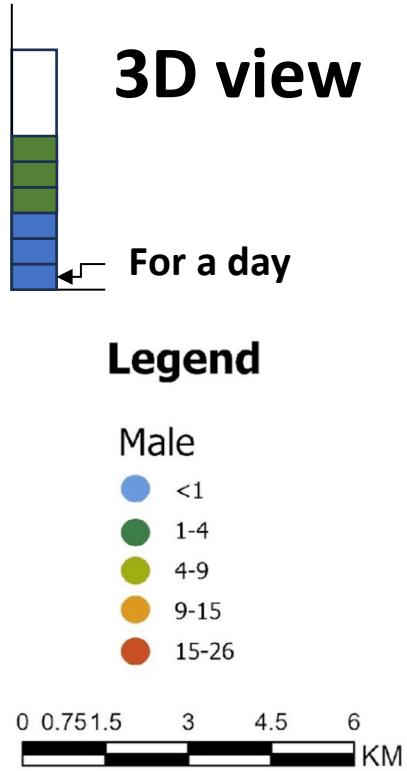
Spatial Coverage for **Male is larger**

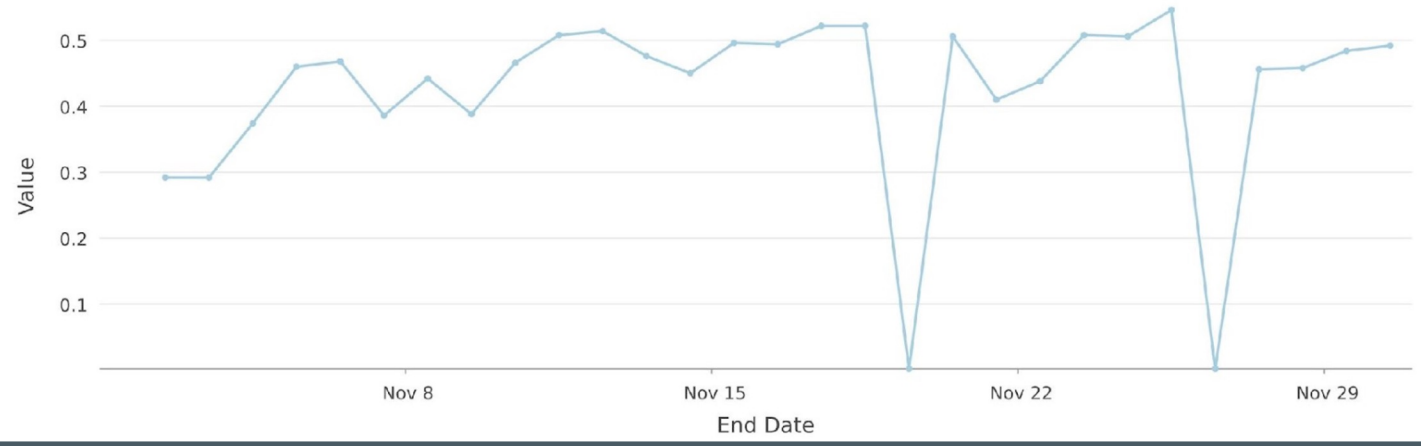


Space Time Cube

Distribution of trips for a month







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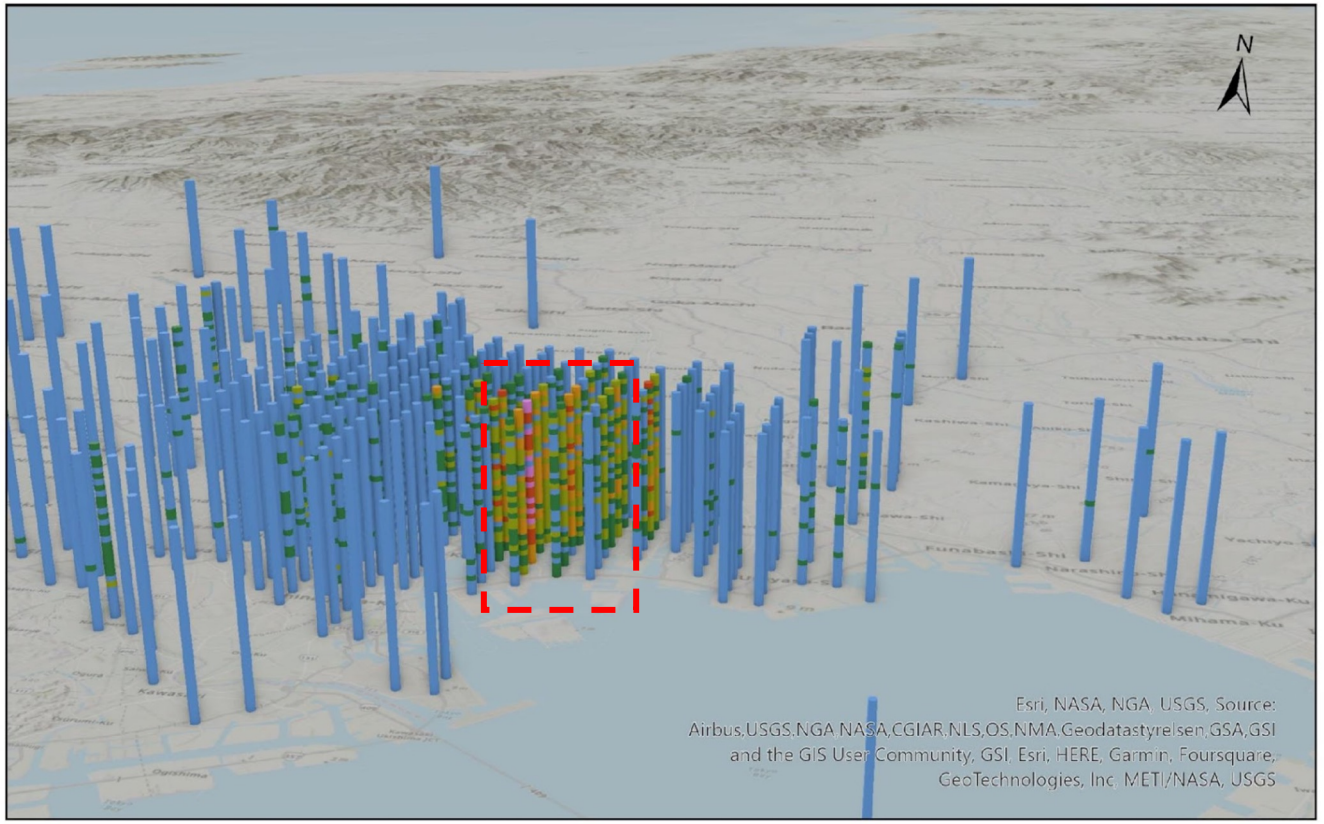
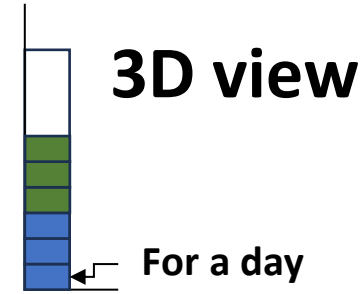
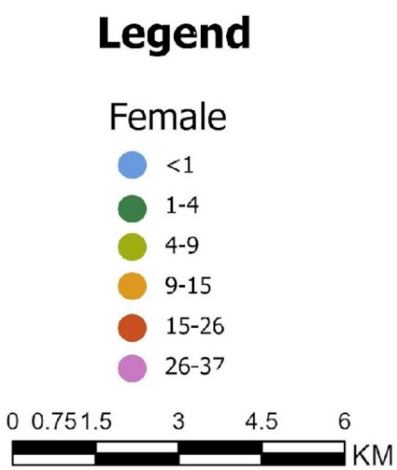
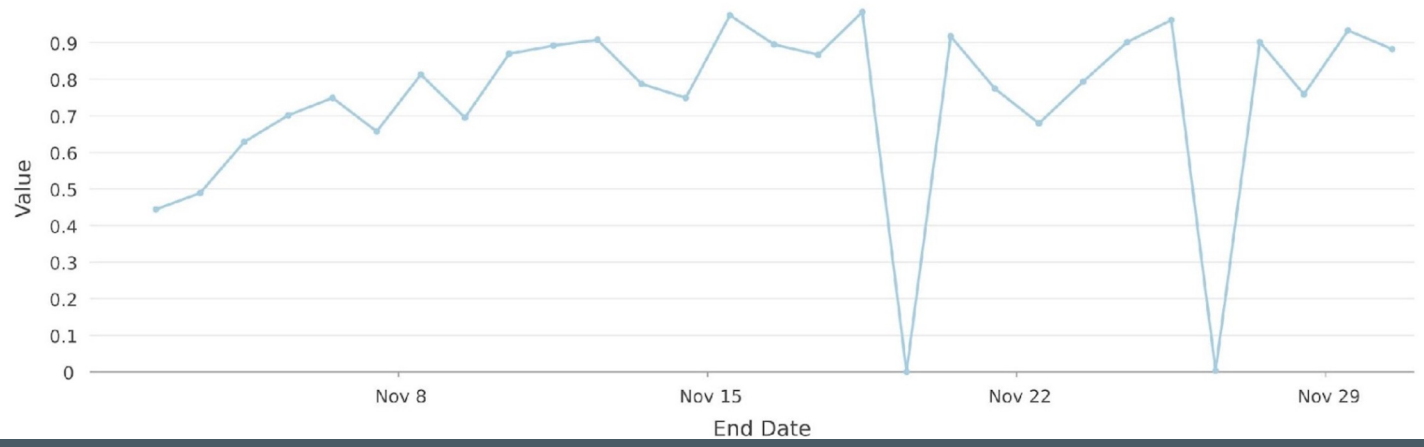


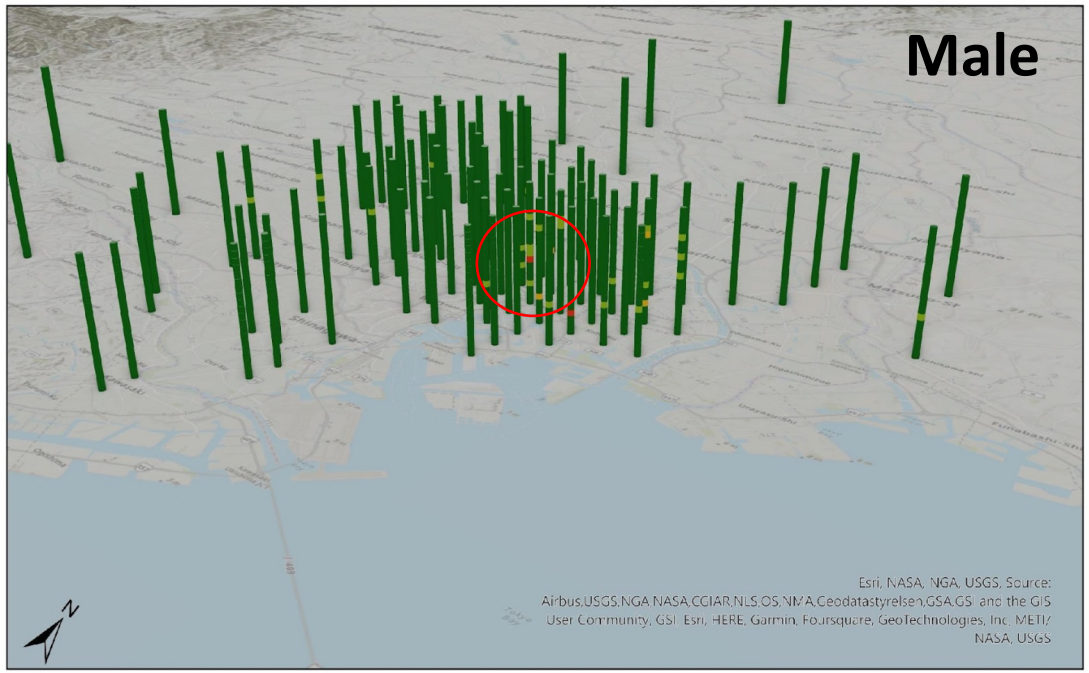


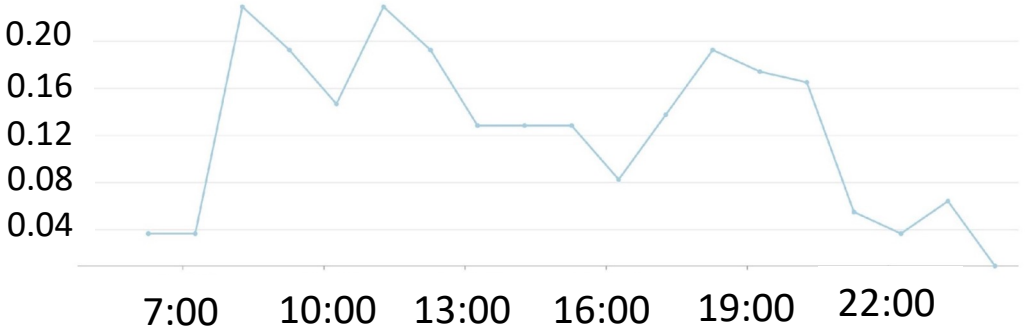


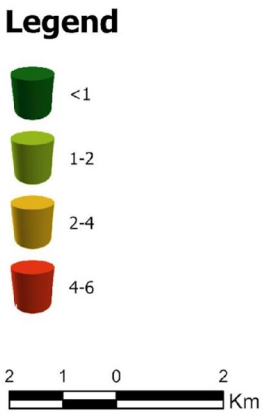


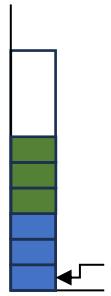
Space Time Cube

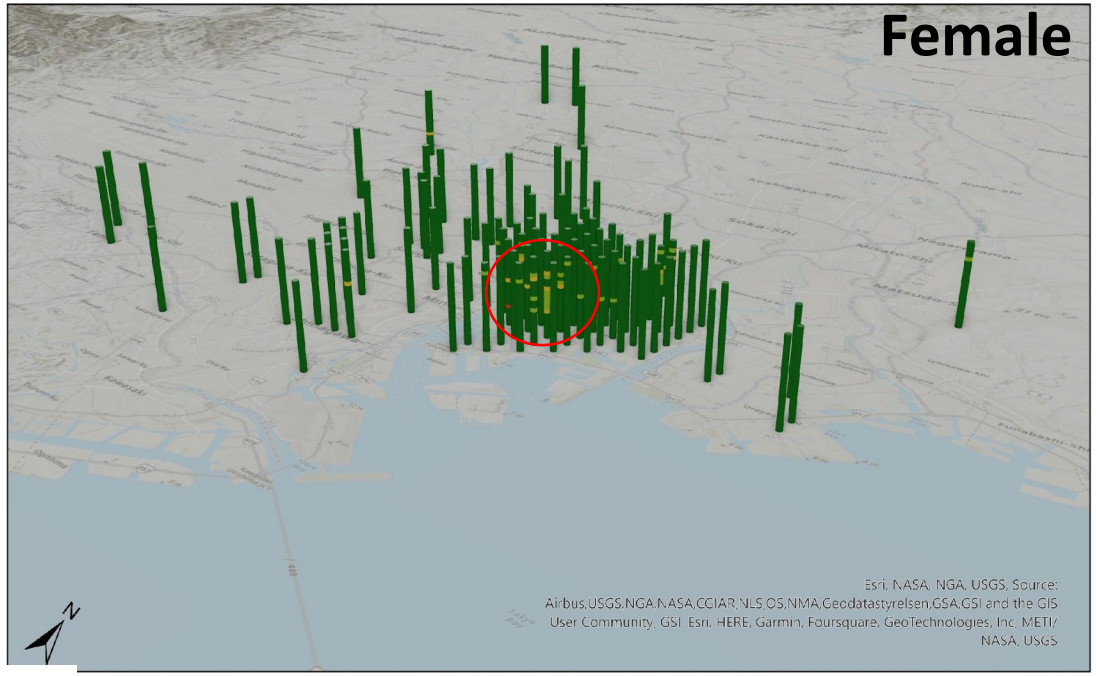
Distribution of trips for a day

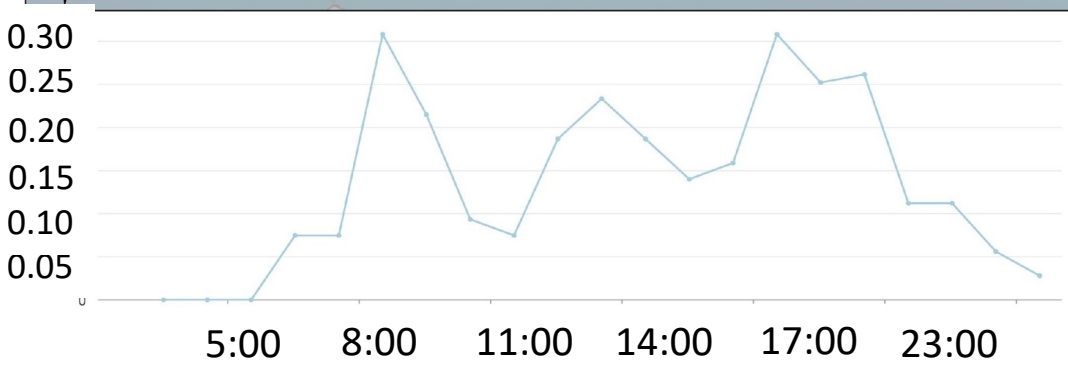












Discussions

Difference in travel Behavior of Men and Women

- As per a study by Collins et al. 2002 found that gender differences in the peak age for travel existed in business and work-related travel. Therefore, the purpose of travel and gender are important factors that need to be considered when predicting the long-term demand for travel.

- As per the World Bank study, typically, women travel shorter distances at off-peak hours, and make chained trips, frequently changing between transport modes to complete multiple tasks, balancing domestic errands and employment.

- Transport Systems are, therefore, needed to collect and analyze gender-disaggregated data to understand women's mobility patterns and design public transport services accordingly.

Difference in travel Behavior of Men and Women

- Safety concern for women may also affect their travel behavior and mode choice. As per ADB 015), Lack of access to safe transport has been identified as a particular constraint to women's labor force participation in developing countries.

- As per a World Economic Forum report of 2018, **70% of women** in Tokyo back single-sex transport amid safety concerns.

- As per the study conducted by Shibata 2020, **25% of women** have experienced groping in the past three years, most often on trains than on buses. It was further concluded that Women-only cars are considered to be a suitable solution but not as effective as surveillance cameras or increased police patrols.

Difference in travel Behavior of Men and Women

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Recommendations

Global Practices

- Safe City Mission in India have introduced women-only buses or train compartments equipped with, CCTV cameras, panic buttons, and better lighting

- **Mexico** have introduced "pink buses" or "women-only" buses to provide a safer and more comfortable commuting experience for women.

- Several **Australian cities** have introduced safety apps that allow passengers to report incidents in real-time and connect with authorities and transport staff.

- **"Hands Off My Buddy" Campaign** in France encourages bystanders to intervene when they witness harassment on public transport and provides information on how to do so safely.

- Although Japan has **Women-Only Train** cars during peak hours to reduce the risk of harassment and overcrowding. Yet, it is it is needed to look into give more attention to the issue of safety for women.

Thank you

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