

Behavior Modelling Summer School
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Changes in Travel Behavior in the Covid-19 Pandemic Period in Toyosu City

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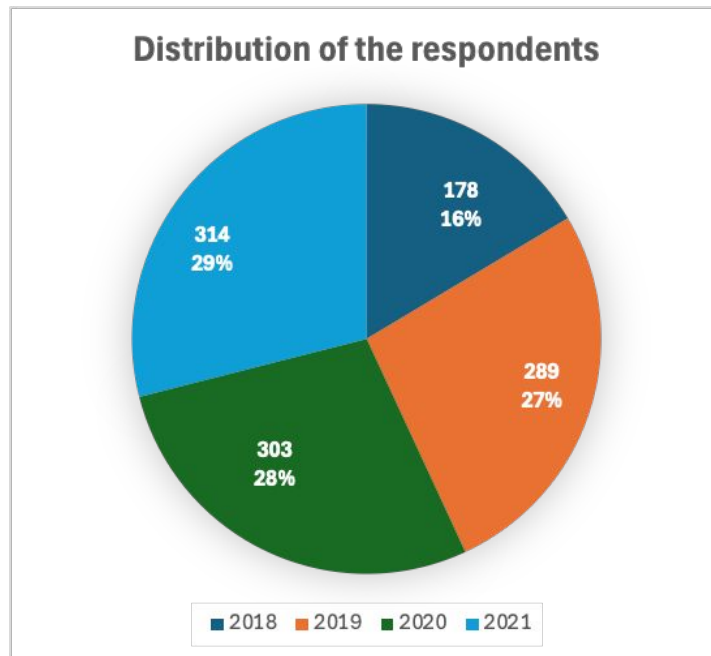
Toyosu City

- Toyosu city's location near central Tokyo makes it valuable for real estate development and Tourism.
- **Toyosu Market (Toyosu Shijō)**: A major wholesale market for seafood, fruits, and vegetables, replacing the historic Tsukiji Market.
- The COVID-19 pandemic has posed significant challenges to development and led to notable changes in people's behavior.



Objectives

To analyse the choices where individuals allocate their time across multiple activities (*e.g., work, school, shopping, stay at home, leisure, tourism*) **before** and **after** the COVID-19 pandemic.



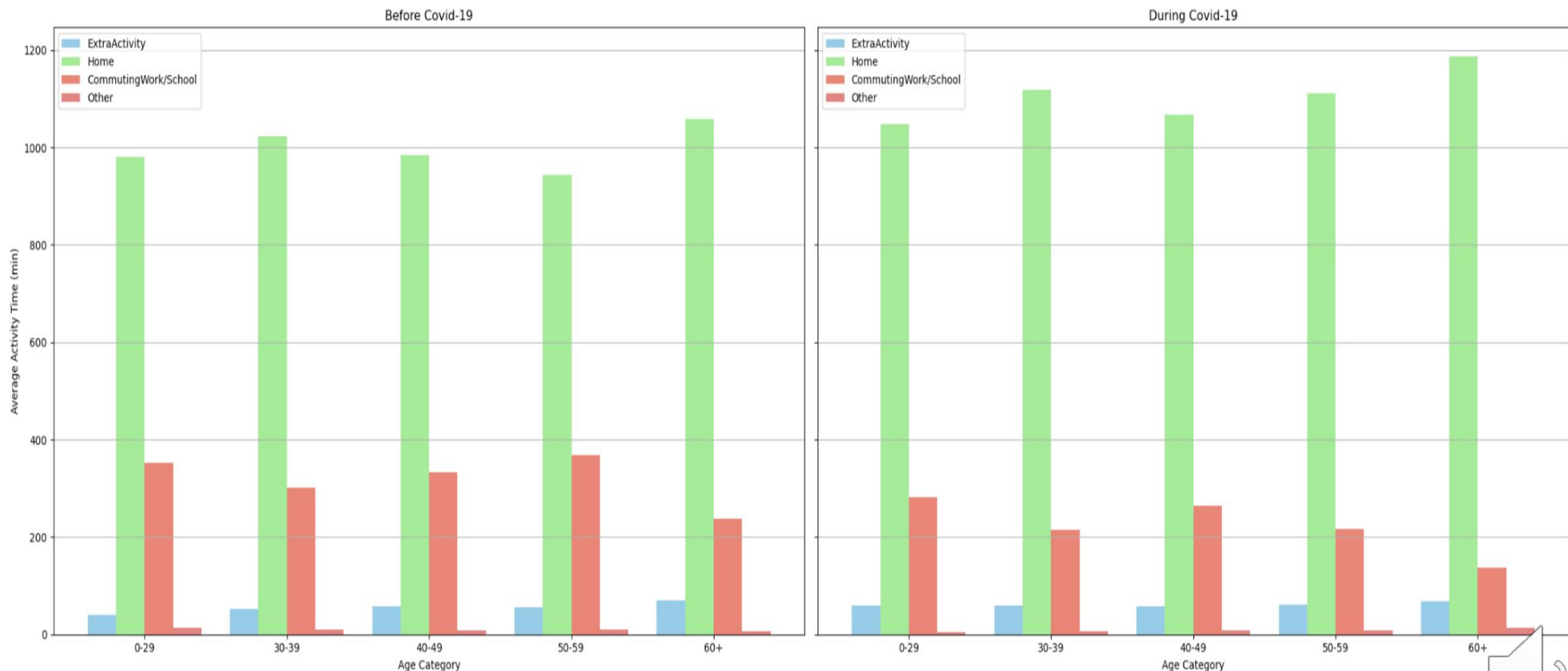
Dataset

- PP Data (2018 – 2021)
- PT data
- From Purpose of Trip
- Departure and Arrival Time
- Trip Duration
- Age, Sex, income, etc



Across all age categories: Before Covid-19 to During Covid-19

- Home activity has **increased**;
- Commuting to Work Place/School activity has **decreased**.



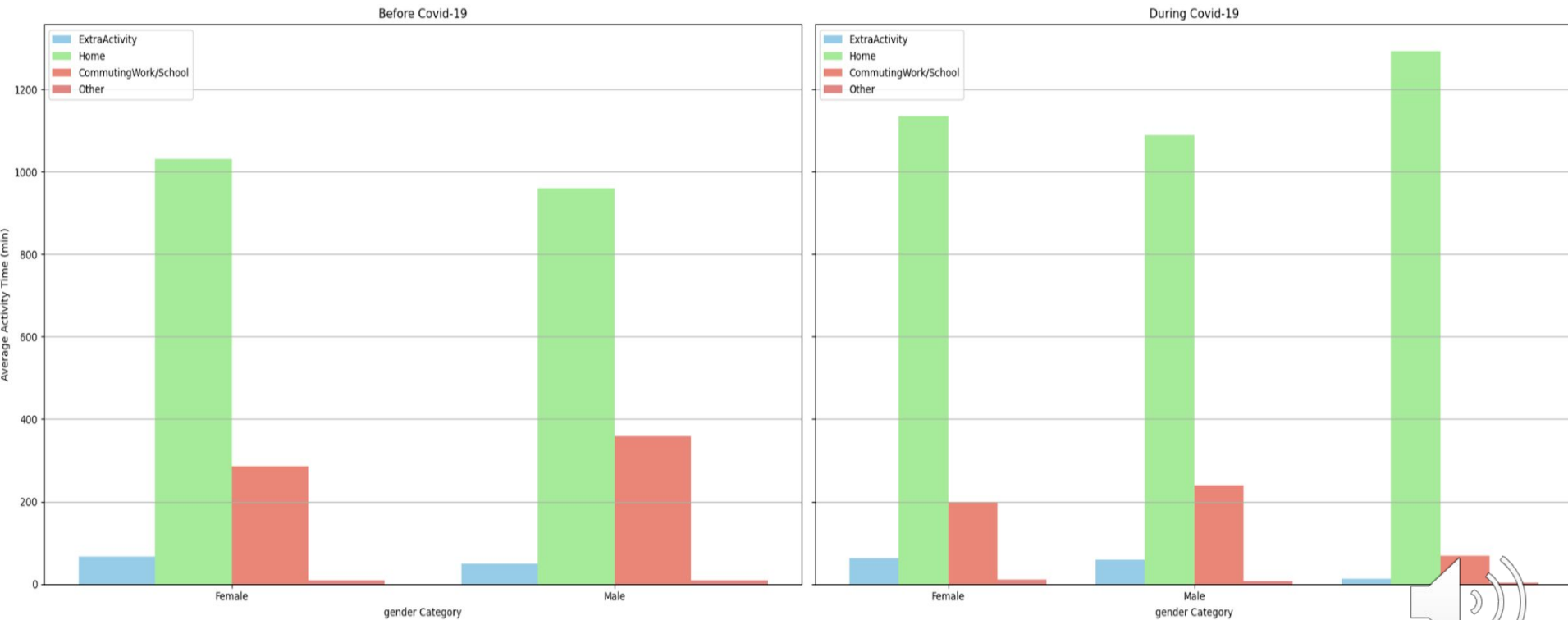
*Extra activity: Leisure, Shopping, Tourism, etc



Across all Gender categories: Before Covid-19 to During Covid-19

Home activity has **increased**;

Commuting to Work Place/School activity has **decreased**.

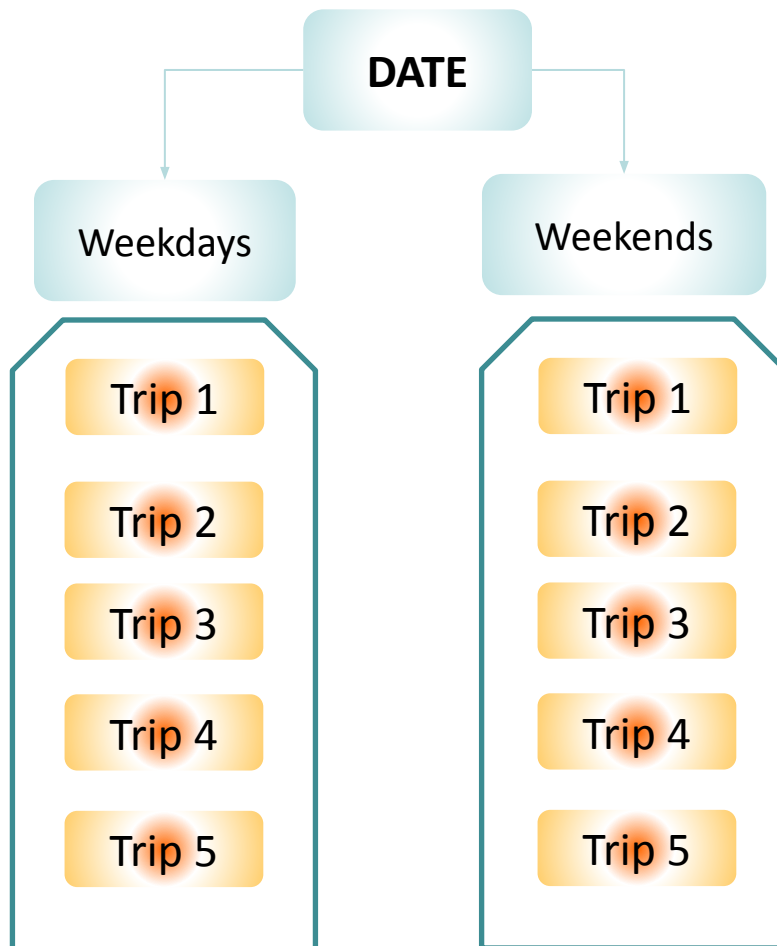


*Extra activity: Leisure, Shopping, Tourism, etc



4.1 Modelling Approach

- To explore travel behavior characteristics before and after Covid-19 Pandemic



4.1 Modelling Approach

To explore travel behavior characteristics before and after Covid-19 Pandemic where individuals allocate their time across multiple activities with each activity

Variable	Description
Individual ID	Respondent ID
date	Index of weekday and weekend
Budget [minutes]	Total amount of time register during the day
t_01	Time spent for commuting
t_02	Time spent for bussiness
t_03	Time spent for shopping
t_04	Time spent for others
t_n	etc



4.2 Model Estimation

- **Multiple Discrete-Continuous Extreme Value (MDCEV) model** is used to model choices where individuals allocate their time across multiple activities, with each activity potentially receiving a different amount of time.
- **MDCEV Utility Function:**

The total utility U for an individual n choosing to allocate time across J activities is given by:

$$U_n = \sum_{j=1}^J \frac{\alpha_j}{\gamma_j} (1 - e^{-\gamma_j x_{nj}}) + \sum_{j=1}^J \delta_j Z_{nj}$$

- **Budget Constraint:**

The total time an individual can allocate is constrained by their available time budget, typically 24 hours:

$$\sum_{j=1}^J t_{nj} \leq 24 \text{ hours}$$



4.2 Modelling Approach

Where:

- x_{nj} : the time spend for activity j by individual n.
- α_j : the marginal utility of activity j.
- γ_j : a satiation parameter for activity j (i.e., a parameter that controls diminishing returns as more time is spent on activity j).
- δ_j : the base utility of activity j, including the influence of socio-demographic factors.
- Z_{nj} : represents socio-demographic variables such as age, post-COVID (post), income level, etc.
- The first term represents the continuous consumption of time, while the second term captures the baseline utility of choosing activity j.



Pre Covid-19 Pandemic vs During Covid-19 Pandemic

	Pre-Pandemic			During-Pandemic		
	Estimate	rat.(0)	Rob	Estimate	rat.(0)	Rob
alpha_base	-15.354	-0.219		-15.026	-0.275	
gamma_work	2.341	14.89	***	3.397	16.157	***
gamma_school	3.251	20.717	***	3.475	25.087	***
gamma_shopping	3.079	14.012	***	4.43	20.113	***
gamma_private	2.496	8.018	***	2.232	12.763	***
gamma_leisure	4.719	12.23	***	7.377	17.308	***
delta_work	-3.569	-68.066	***	-3.788	-55.697	***
delta_shopping	-2.975	-109.783	***	-2.381	-133.81	***
delta_private	-5.12	-69.901	***	-4.473	-93.717	***
delta_leisure	-3.621	-78.225	***	-3.082	-124.621	***
delta_work_FT	0.003	0.108		0.03	1.133	
delta_work_wknd	-0.698	-5.313	***	-0.623	-5.895	***
delta_leisure_wknd	0.945	13.896	***	0.449	11.956	***
theta_optional	0.664	34.037	***	0.556	48.027	***
LL(start)	-23696.39			-38807.54		
LL(final)	-18195.01			-30738.04		
AIC	36422.02			61508.09		
BIC	36515.86			61608.61		



1. Remote Work and Flexible Schedules:

OPre-Pandemic: Work-related activities were more robust, indicating a higher participation in commuting.

ODuring-Pandemic: Decline in work-related activity.

ORecommendation: Encourage **remote work** and **flexible work schedules**. This would reduce commuting times, improve work-life balance.

2. Support for E-commerce and Local Retail:

OPre-Pandemic: High participation in in-person shopping trips.

ODuring-Pandemic: Significant reduction in physical shopping

ORecommendation: Provide **support for digital transformation** and incentivize **local shopping** through e-commerce platforms.

3. Promotion of Safe Leisure Activities:

OPre-Pandemic: High engagement in leisure activities, particularly on weekends.

ODuring-Pandemic: Leisure activities declined, with a focus on weekends for flexibility.

ORecommendation: Invest in **outdoor leisure spaces** and **weekend recreation**

4. Sustainable Transport and Mobility Solutions:

OPre-Pandemic: Frequent use of public transport and commuting for work and shopping.

ODuring-Pandemic: Decline in transport use.

ORecommendation: Promote **alternative transport modes** such as cycling and walking



Thank you very much!

