

Analysis of the Determinants of Travel Mode Choice

交通手段選択発生要因の分析

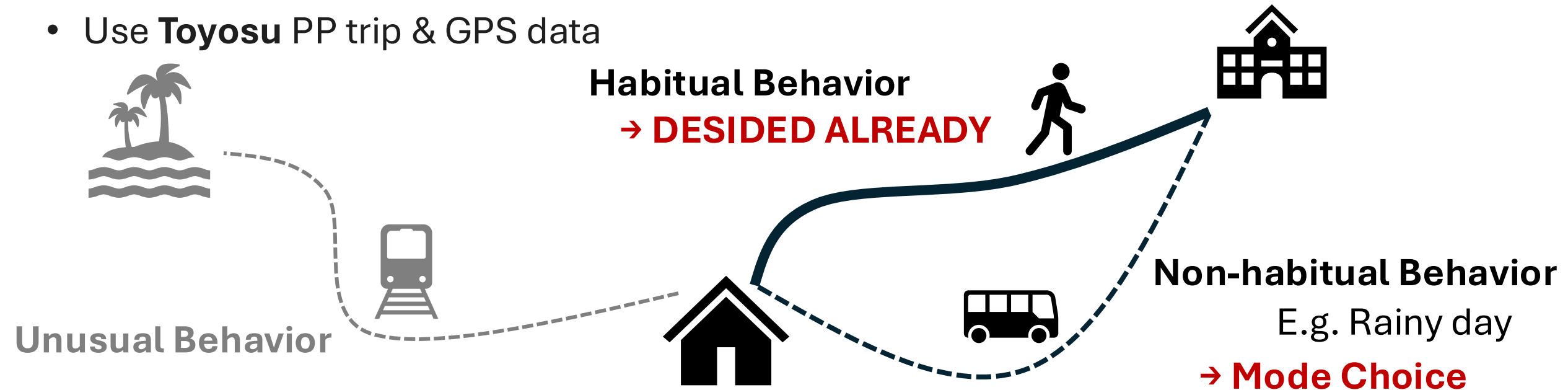
Tsukuba U. Team C

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Background

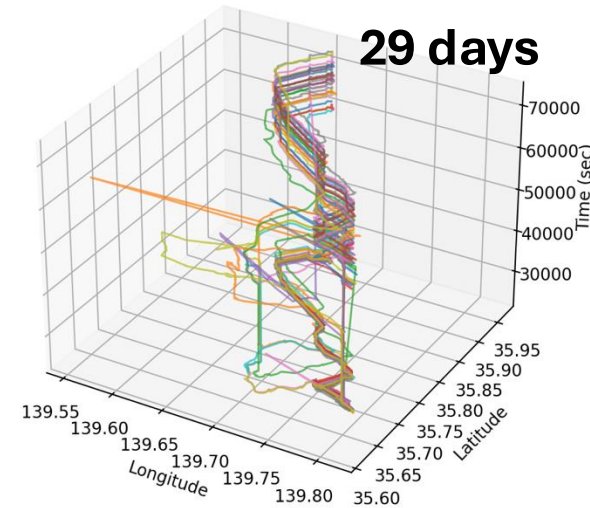
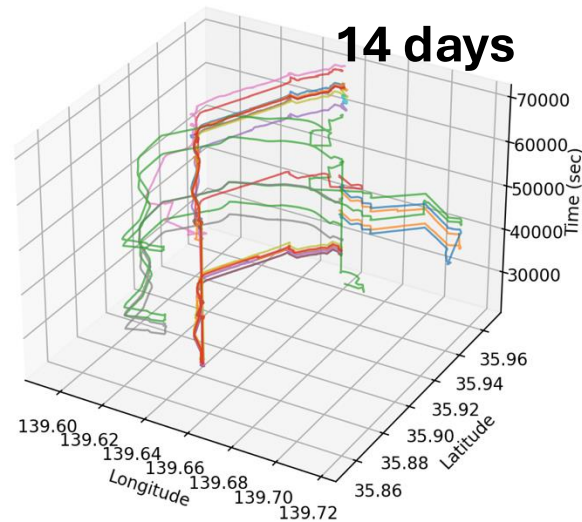
- Many existing models of transportation mode choice assume that people make a choice for every trip.
- But do you really think about which mode of transportation you will use for every trip every day?
- It seems that people do not choose transportation modes based **on habitual behavior**, and only consider it when they are **unable to do the same thing as usual**.
- Use **Toyosu** PP trip & GPS data



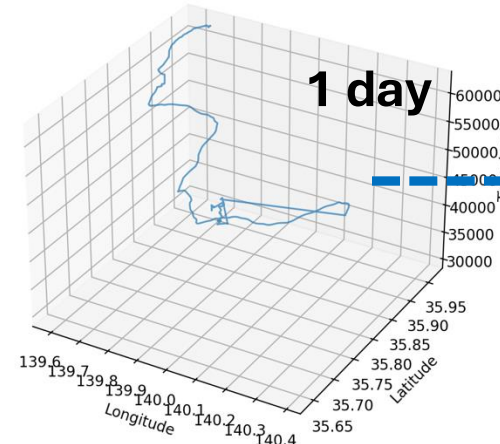
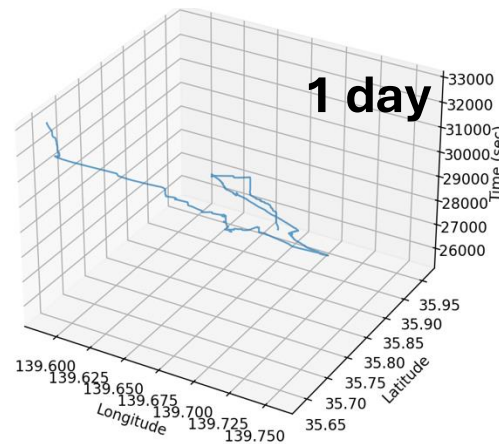
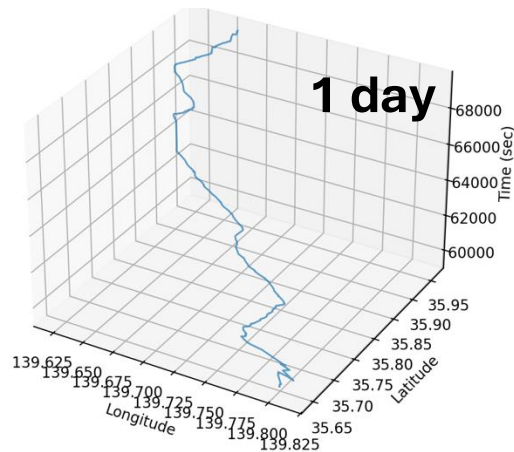
Basic Analysis

- Sort out “Unusual” trips referred from the GPS data
- method: K-means clustering

e.g. User 4080's Trajectories



----- Trips for daily activities
→ objectives



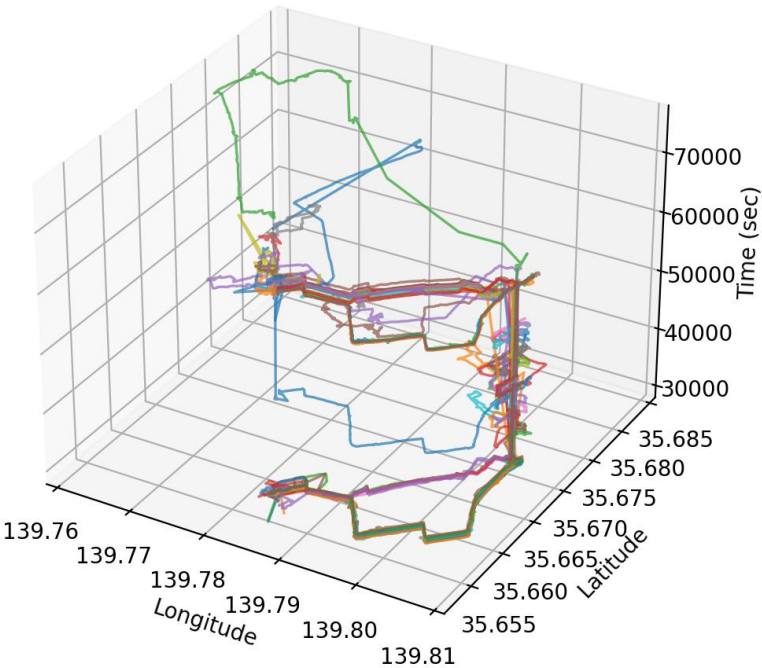
----- Trips for exceptional
activities → removed

Classify non-habitual behaviors

- **method: Similarity determination algorithm**

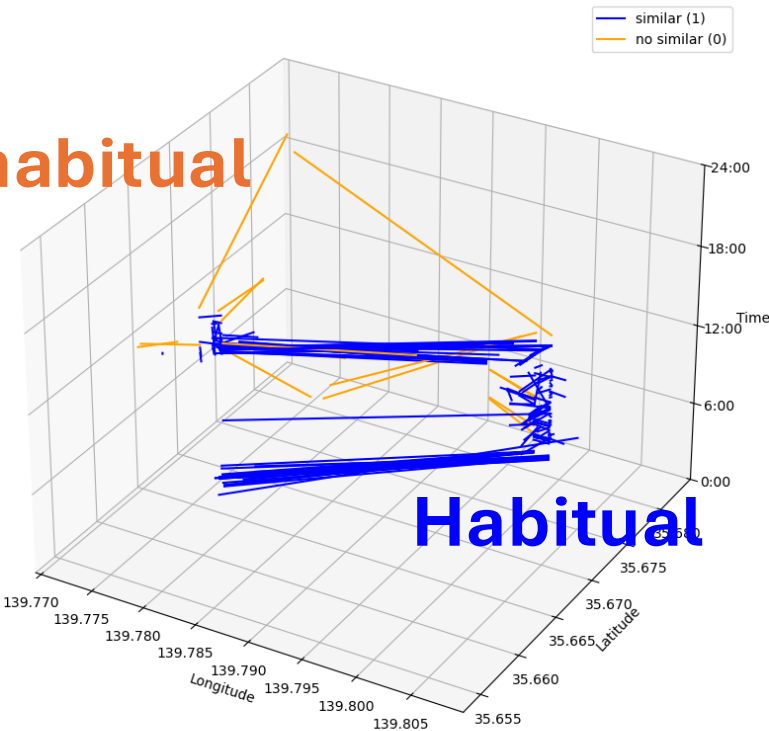
Judgment criteria : Latitude & longitude of origin & destination, Travel time

User 4023 — Cluster 0 (3D) | days=36



User 4023, Cluster 1

Non-habitual



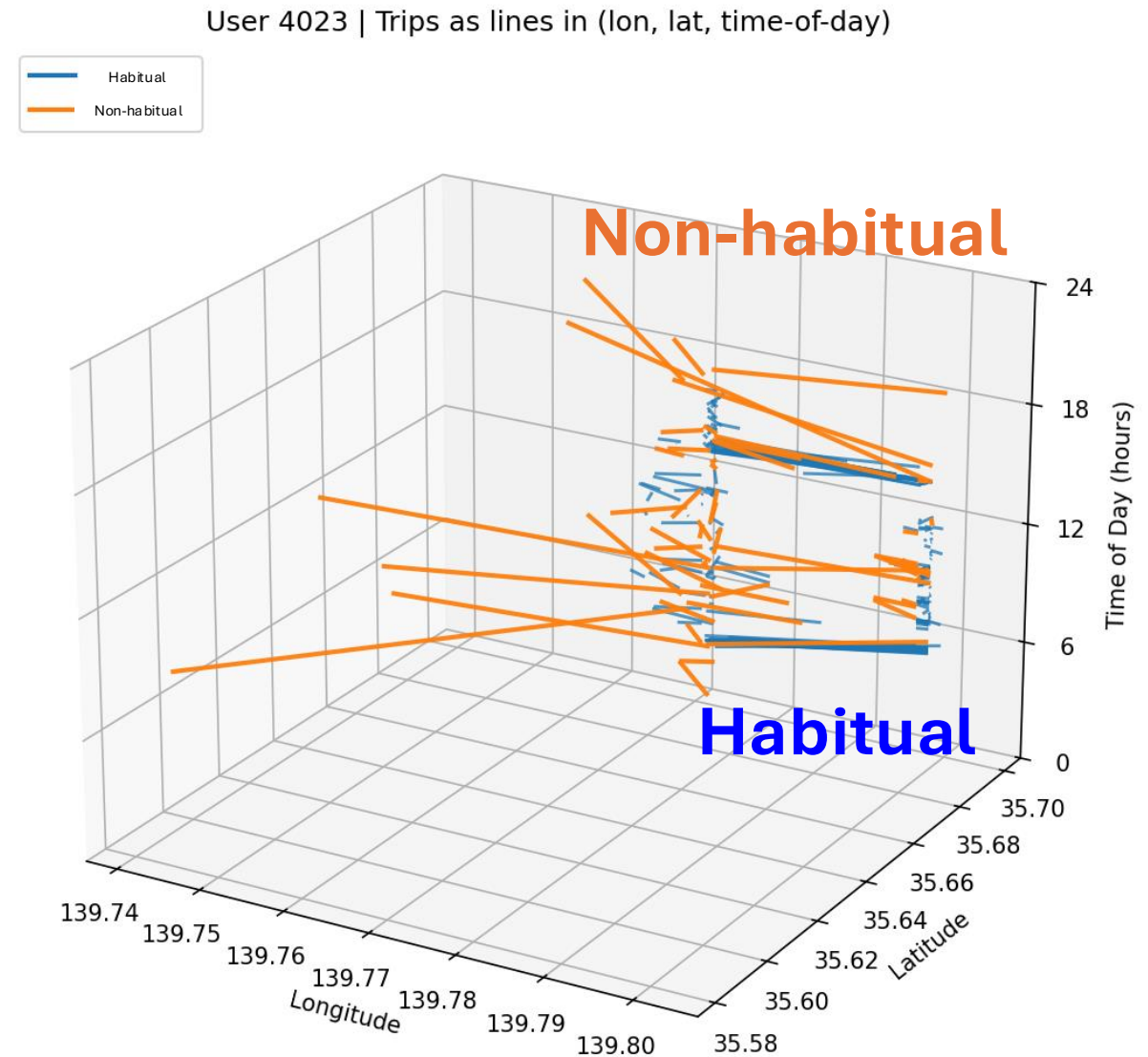
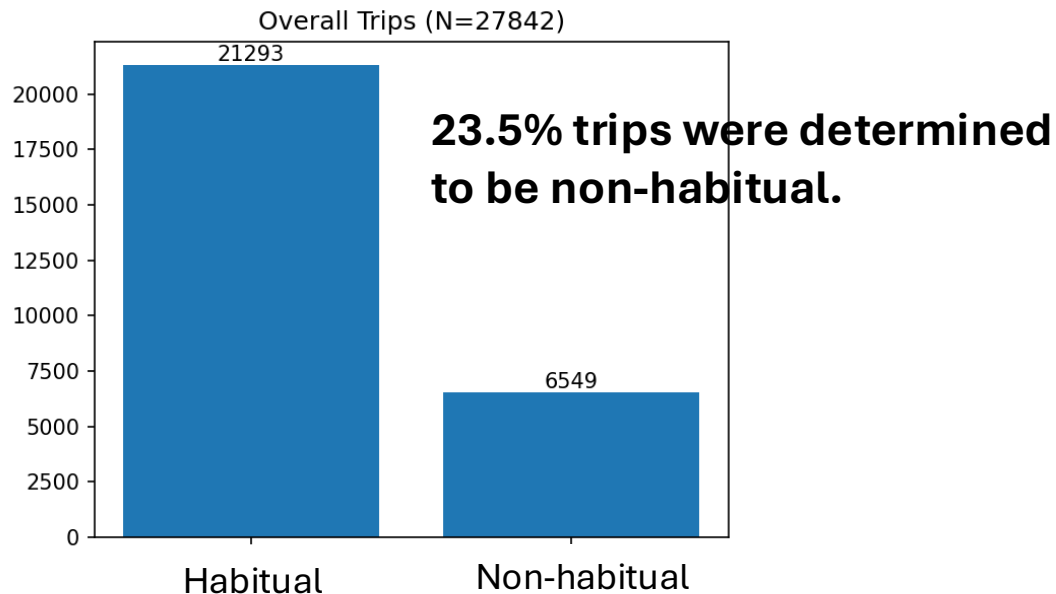
Threshold Strictness	Habitual Trips	Non-Habitual Trips
Strong	10,670 (48%)	11,525 (52%)
Medium	12,080 (54%)	10,123 (46%)
Weak	13,627 (61%)	8576 (39%)

Classify non-habitual behaviors

- **method2 : Unsupervised learning**

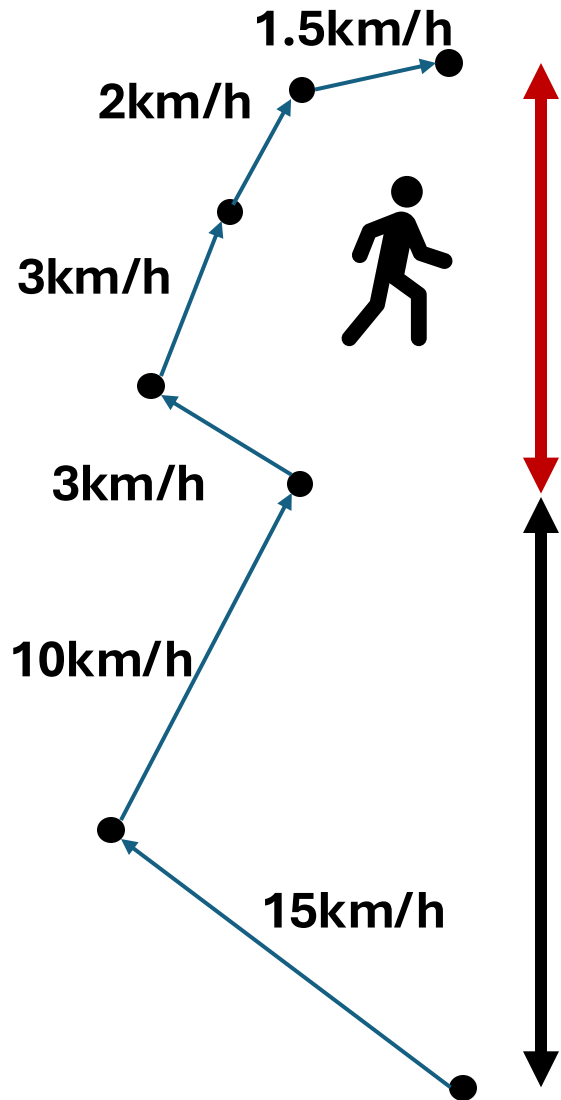
Compare 4 features

- Neighborhood search (build similar-trip set N)
- Mode surprise (rare mode in neighborhood)
- Travel-time deviation (duration/pace outlier)
- Low density (vector-rare / density outlier)



Basic Analysis

- Use Walking Speed referred from the GPS data

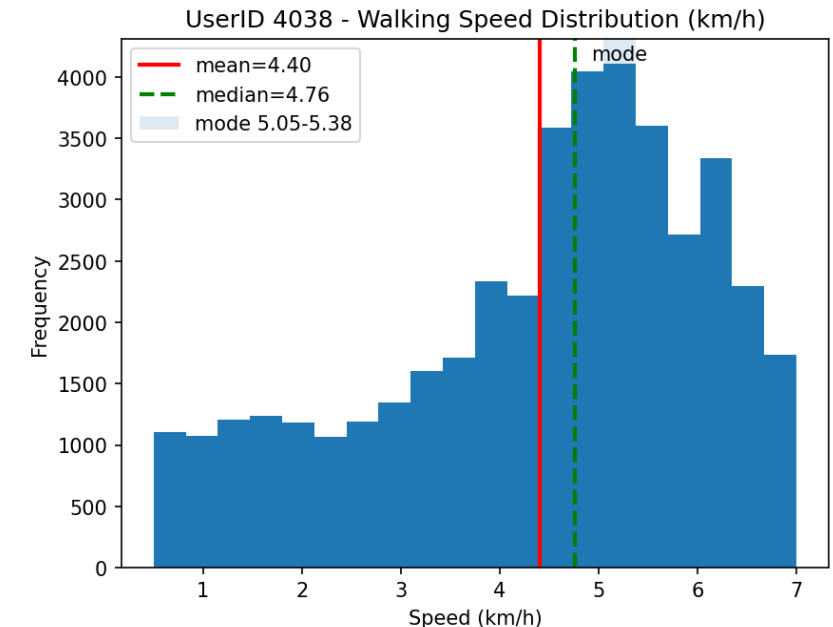
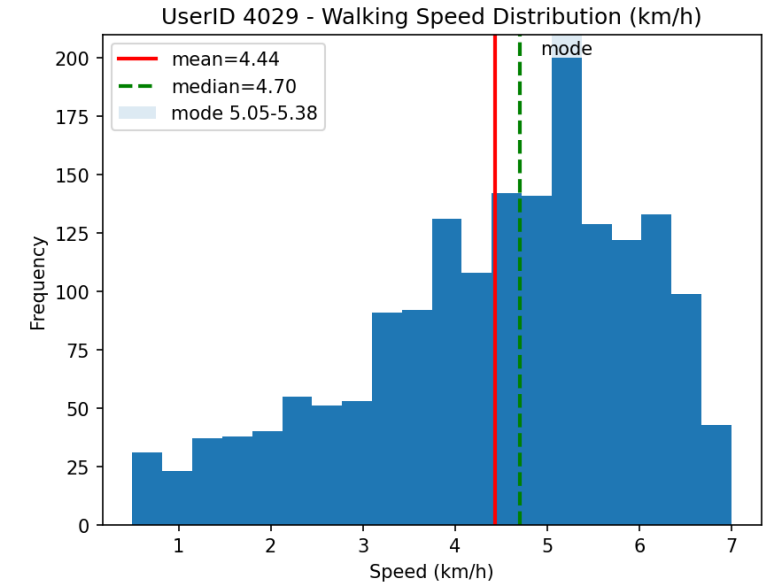


Consider the movements with speed under 7km/h as “Walking”

Calculate mean walking speeds by each user and each trip separately

Distinguish users' non-habitual walking speeds by comparing with User mean and trip mean

切羽詰まったダミー
“High speed than usual” dummy

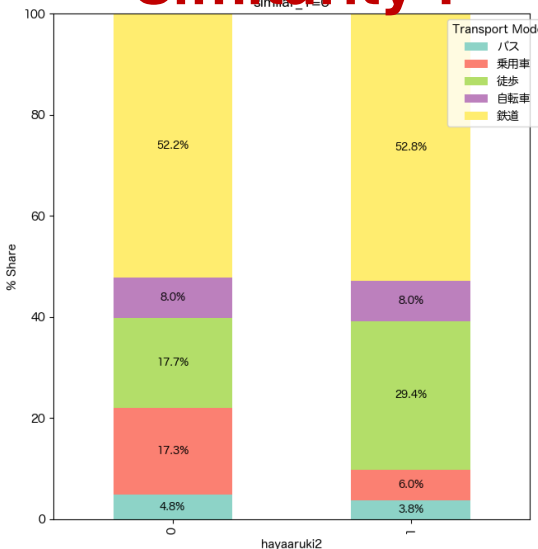


Basic Analysis

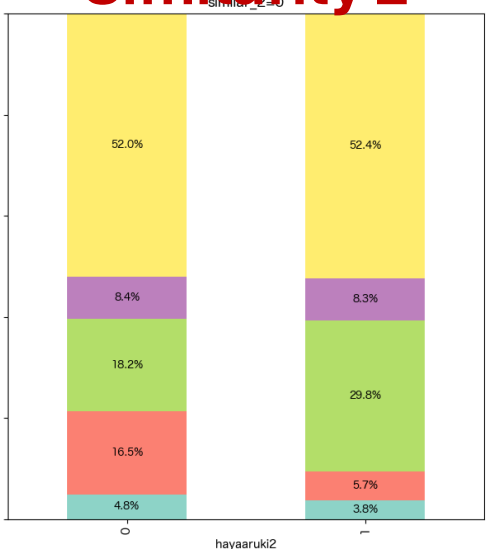
- [Results] The effect of 切羽詰まったダミー “High speed than usual” dummy to the Mode Choice

Non-habitual

Similarity 1



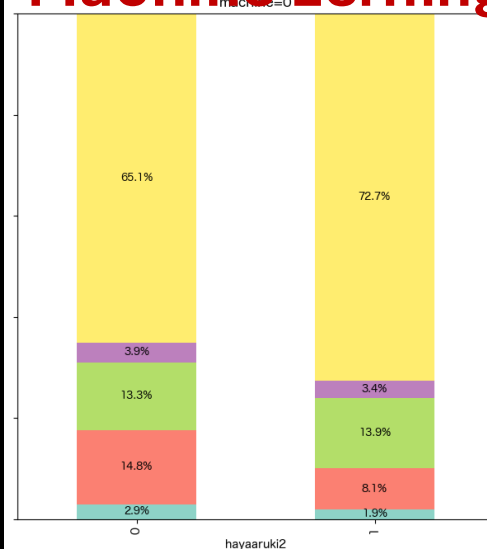
Similarity 2



Similarity 3

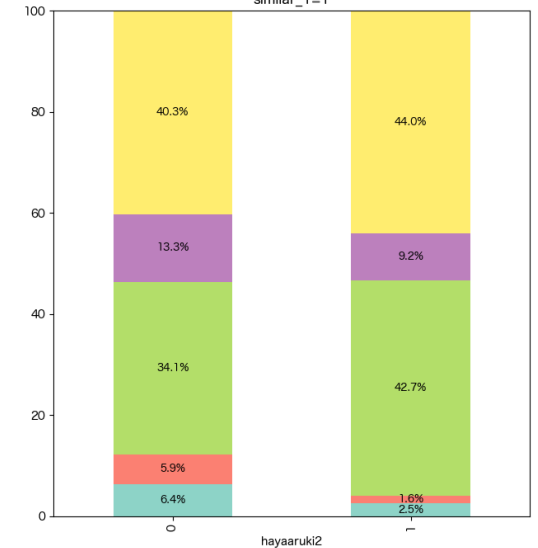


Machine Learning

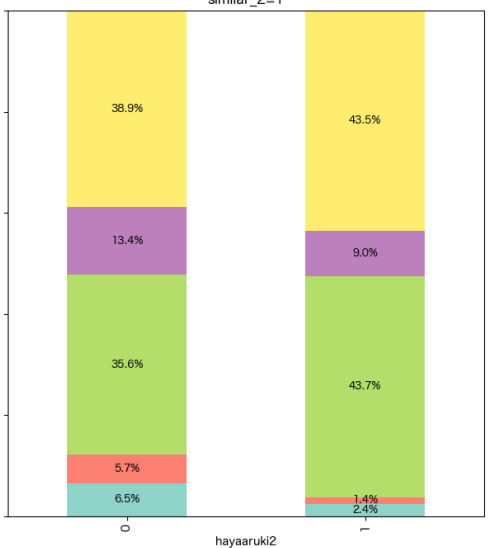


Habitual

similar_1=1



similar_2=1



similar_3=1



machine=1



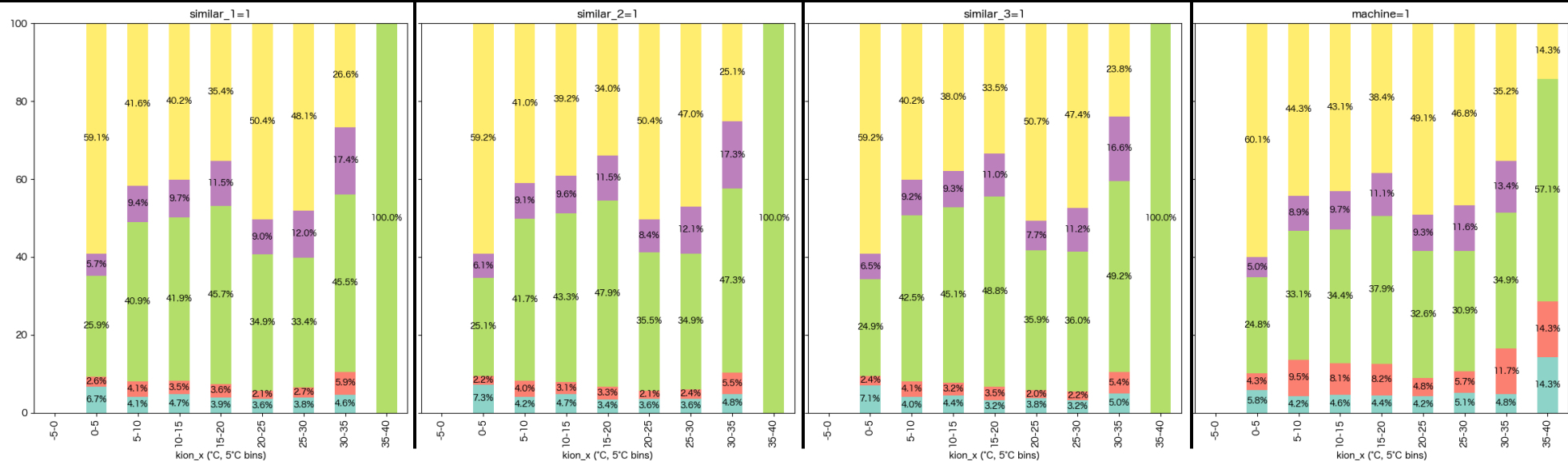
Basic Analysis

● [Results] The effect of 気温 “temperature” to the Mode Choice

Non-habitual



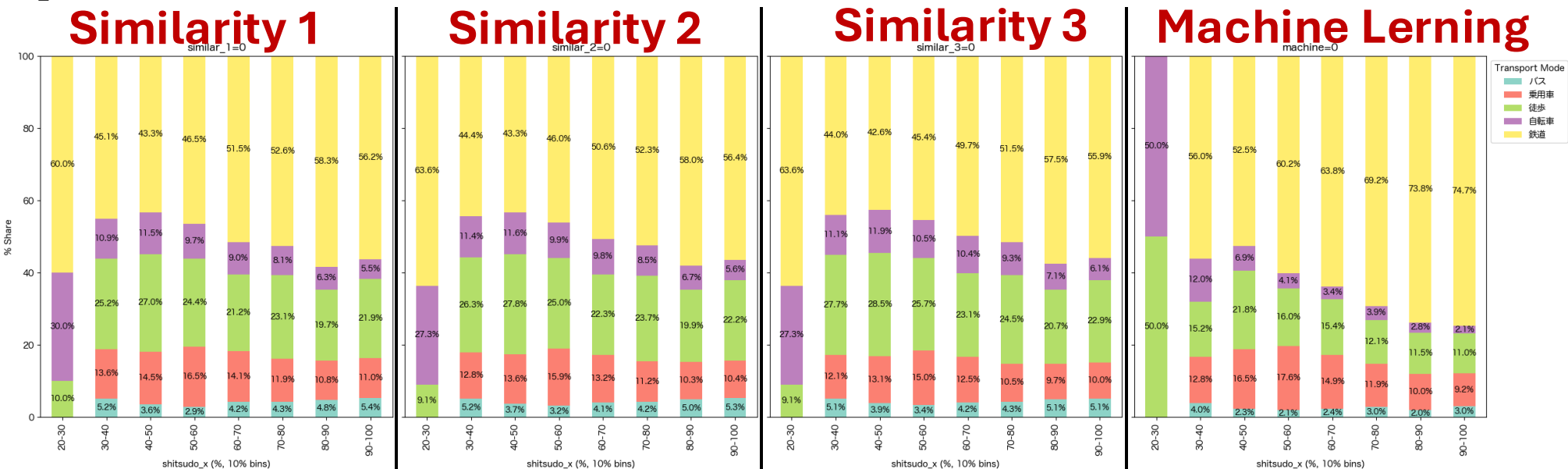
Habitual



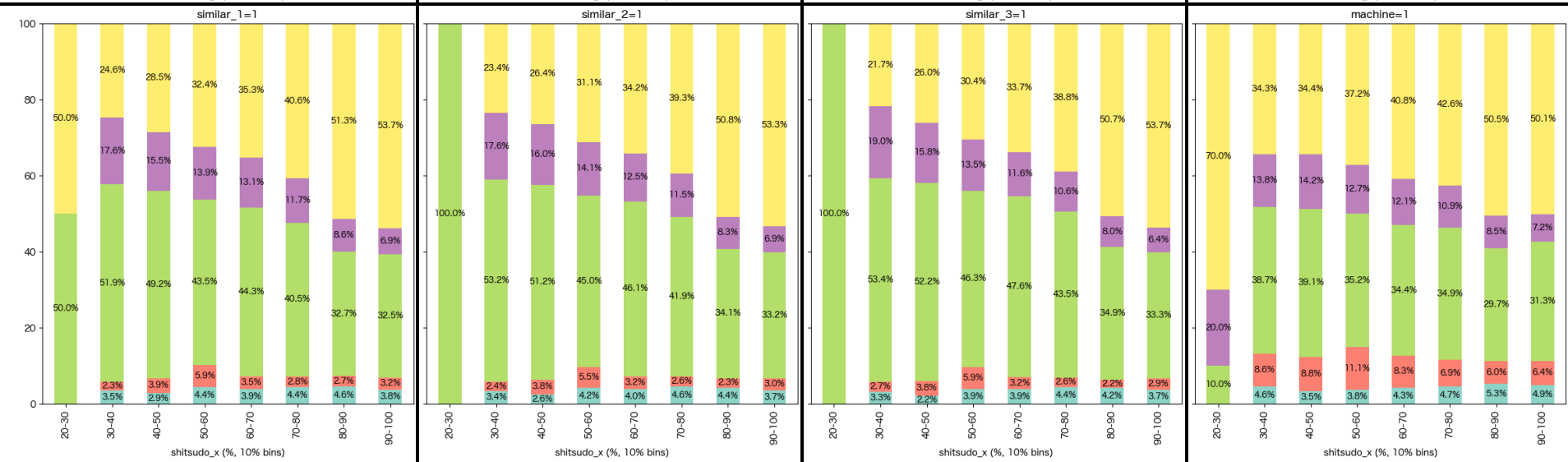
Basic Analysis

● [Results] The effect of 湿度 “hummid” to the Mode Choice

Non-habitual



Habitual



Model Comparison

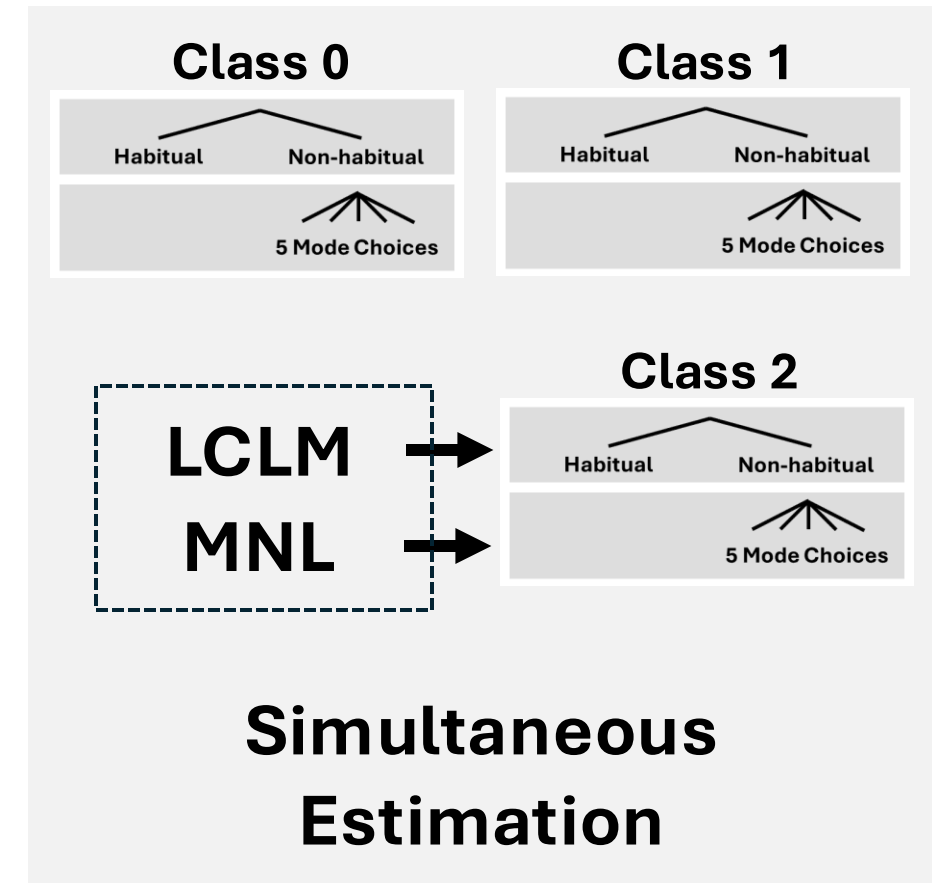
LCLM + MNL

- The population is assumed to be made up of **latent classes** (different in preferences that we cannot directly measure)
- Each individual has a probability of belonging to a certain class
- Parameters vary among classes
- Each parameters are estimated at the same time
- **Upper layer: “Habitual”, “Non-habitual” nests**
- **Lower layer: Transportation mode choice based on MNL**



MNL Model

- Adding all parameters in parallel



Compare each Likelihood ratios

Comparison of the LCLM Class

Class of “Similarity 1” (Weak threshold condition)

	Class1_vs_0	Class1_vs_0	Class2_vs_0	Class2_vs_0
	coef	t	coef	t
sex-men	-0.0053	-0.033	-0.51953	-2.87
Age	-0.02005	-0.127	-0.32953	-2.028
Bicycle ownership	0.006321	0.039	0.024174	0.144
income level	-0.00357	-0.024	-0.22144	-1.346

- To be grouped by the individual differences
 - Difficult to enter MENS to Class2
 - Easy to enter YOUNGERS to Cass2
 - Bicycle ownership and income were not significant

Estimation of the LCLM

L0 (at theta0): -96086.1

LL (final): -28561.1

Likelihood Comparion between LCLMs (adj.)

Similar1	0.70
Similar2	0.41
Similar3	0.70
MachineLearning	0.80
MNL	0.36

Similar_1

variable	Class0_param	Class0_t	Class1_param	Class1_t	Class2_param	Class2_t
asc_top_habit	0.00	0.01	0.01	0.01	-0.28	-4.33
gamma_shitsudo_x_habit	0.01	1.28	-0.00	-0.61	0.01	16.65
gamma_age_habit	0.01	0.08	-0.00	-0.02	0.05	6.45
gamma_kion_x_nonhabit	-0.02	-1.21	0.01	0.21	0.03	14.84
gamma_kousuiryou_x_nonhabit	-0.01	-0.14	0.00	0.03	0.14	7.83
gamma_walkfast_dammy_nonhabit	0.00	0.00	0.00	0.00	0.00	0.00
asc_train	-0.00	-0.00	0.00	0.01	2.60	65.87
beta_Total_Time_Train_train	-0.00	0.00	0.02	0.01	-1.32	-16.66
beta_Fare_Train_train	-0.01	-0.80	-0.00	-0.54	-0.00	-12.80
asc_bus	0.01	0.01	-0.01	-0.02	1.32	16.36
beta_Time_Bus_bus	0.01	0.00	-0.01	0.00	-0.22	-0.77
beta_Fare_Bus_bus	0.00	0.13	0.01	1.29	-0.01	-9.56
beta_Fare_Train_bus	0.01	4.26	0.01	3.49	-0.00	-5.30
asc_car	0.00	0.04	-0.00	-0.01	-0.62	-24.84
beta_Time_Car_car	-0.01	-0.00	-0.01	-0.01	0.02	0.17
beta_Fare_Train_car	0.00	1.52	-0.01	-2.63	-0.00	-2.01
beta_Fare_Bus_car	-0.01	-2.70	0.01	2.86	-0.00	-5.59
beta_Time_Walk_walk	0.01	0.02	0.01	0.01	-0.48	-24.28
asc_bike	-0.00	0.00	0.01	0.00	0.01	0.00
beta_Fare_Train_Pred_bike	-0.00	0.00	-0.01	0.00	0.01	0.00
lambda_nonhabit	0.85		0.85		1.09	22.09