Transportation model of Trip Characteristic on Companionship

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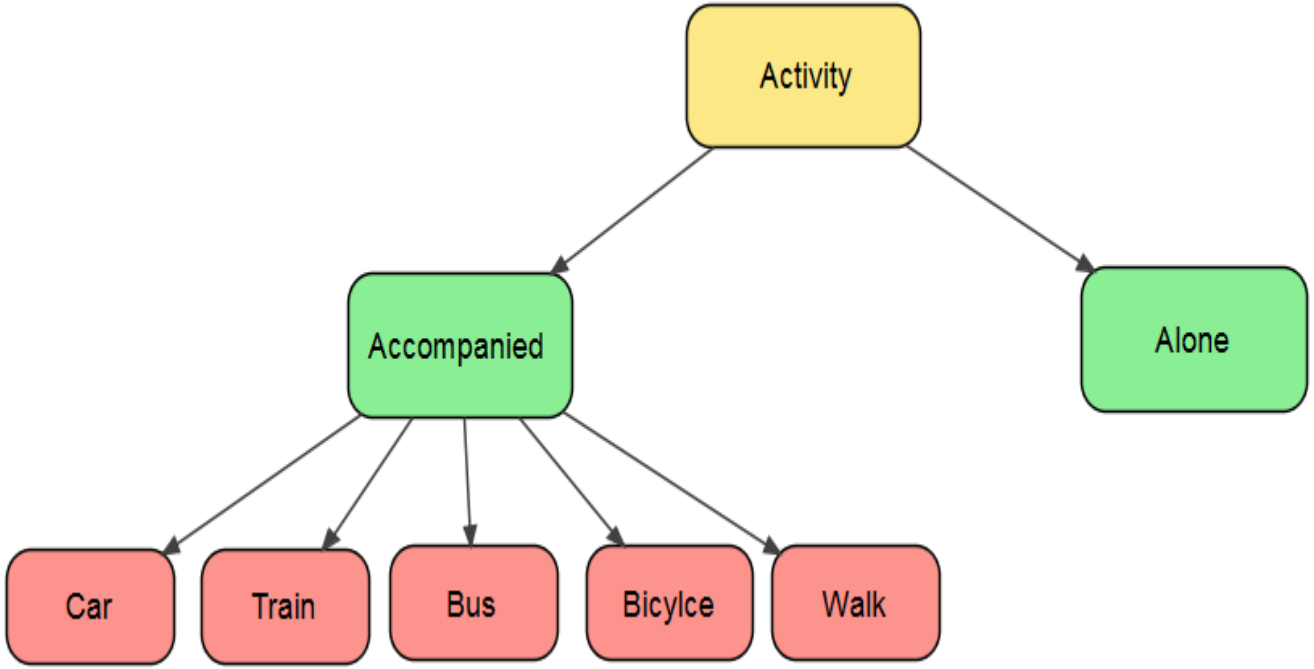
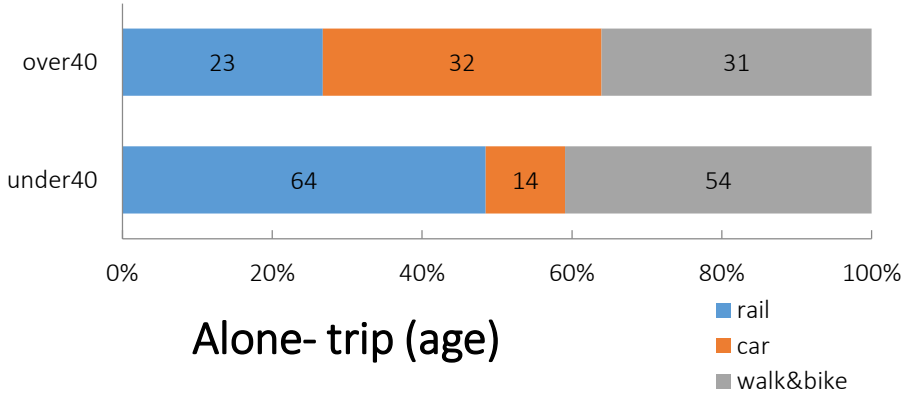
Team D

Hypothesis

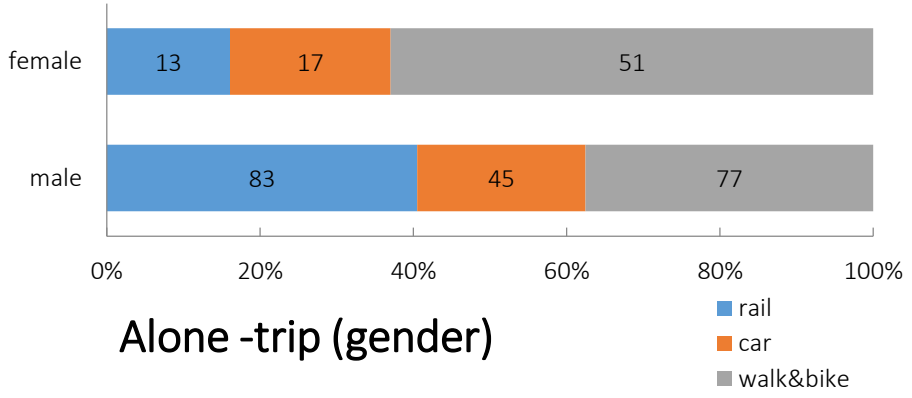
Companionship has big effect on activity.



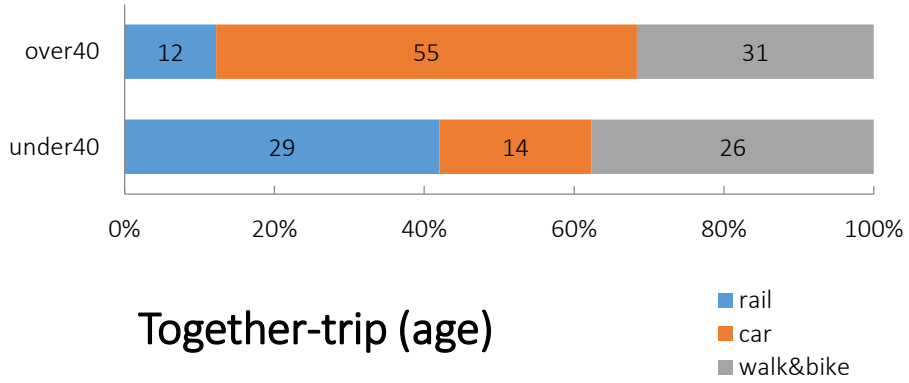
Basic analysis



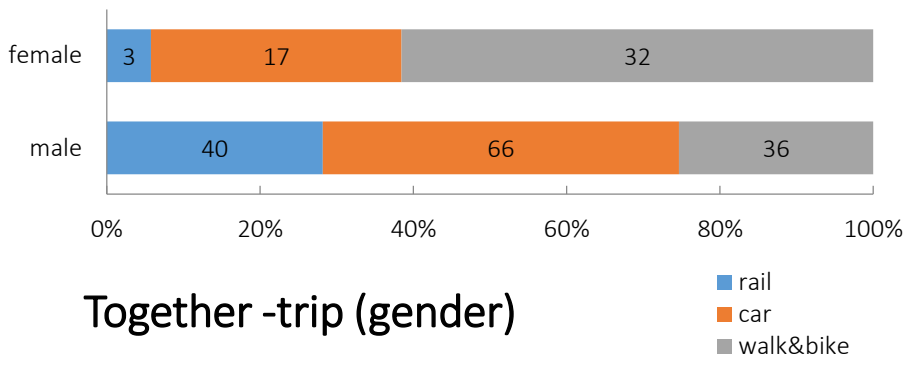
Alone- trip (age)



Alone -trip (gender)

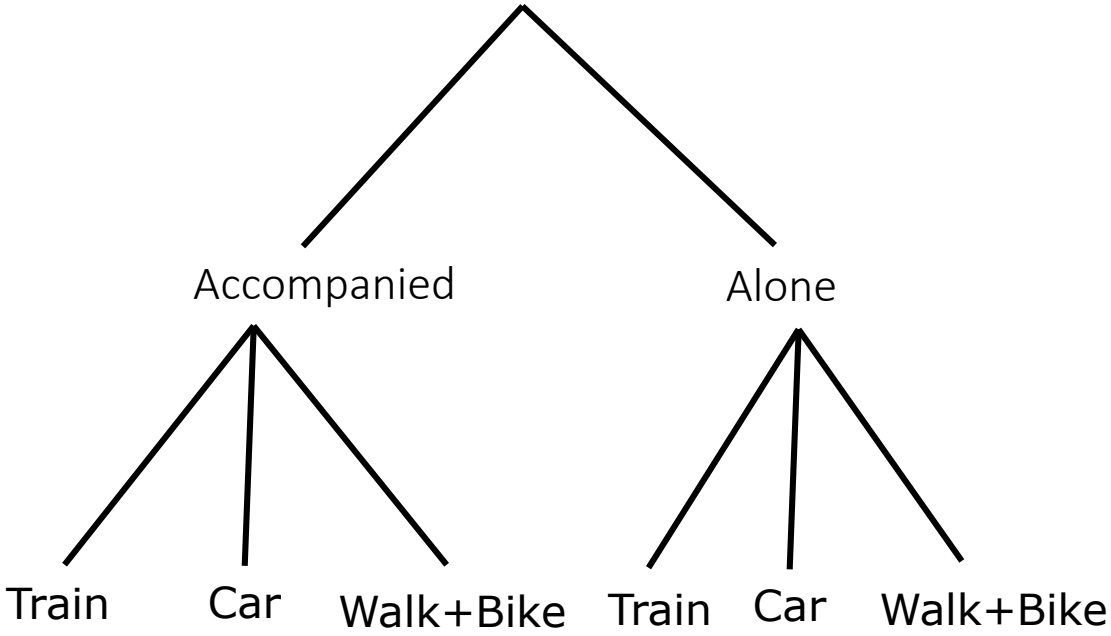


Together-trip (age)



Together -trip (gender)

Model of our Analysis



Analysis 1

$$
\begin{aligned}
U_{trainalone} &= V_{01} + \varepsilon_{01} = d_{01}(timetrain) + d_{02}(fare) + d_{03}(age) + b_1 + \varepsilon_{01} \\
U_{caralone} &= V_{02} + \varepsilon_{02} = d_{01}(timecar) + d_{03}(age) + b_2 + \varepsilon_{02} \\
U_{walk+bicyclealone} &= V_{03} + \varepsilon_{03} = d_{01}(timewalk + timebike)/2 + d_{03}(age) + b_3 + \varepsilon_{03} \\
U_{trainalone} &= V_{11} + \varepsilon_{11} = d_{11}(timetrain) + d_{12}(fare) + d_{13}(age) + b_4 + \varepsilon_{11} \\
U_{caralone} &= V_{12} + \varepsilon_{12} = d_{11}(timecar) + d_{13}(age) + b_5 + \varepsilon_{12} \\
U_{walk+bicyclealone} &= V_{13} + \varepsilon_{13} = d_{11}(timewalk + timebike)/2 + d_{13}(age) + b_6 + \varepsilon_{13}
\end{aligned}
$$

$$P_n(i,c) = P_n(i)P_n(i \mid c)$$

$$P_n(i) = \frac{\exp(\lambda \Lambda_{nc})}{\sum_{c=1}^{2} \exp(\lambda \Lambda_{nc})}$$

$$P_n(i \mid c) = \frac{\delta_{nci} \exp(V_{ni} + V_{nci})}{\sum_{j=1}^{3} \delta_{ncj} \exp(V_{nj} + V_{ncj})}$$

$$\Lambda_{nc} = \ln \sum_{i'}^{3} \exp(V_{ni'} + V_{nci'})$$

$$i \in j = \{1,2,3\}$$

$$\{\delta_j : \text{mode availability} \mid 1,0\}$$

Analysis 1

	parameter	T value
constant(trainalone)	0.61	1.53
constant(caralone)	-1.07	-3.04**
constant(walk+bikealone)	0.82	2.30**
constant(trainaccompanied)	-0.16	-0.59
constant(caraccompanied)	-0.81	-4.54**
time	-0.80	-10.2**
time	-0.81	-9.69**
Age	-0.055	-0.0000186
Age	0.055	-0.0000186
Fare	0.11	0.50
Fare	-0.066	-0.24
pa	1.08	2.26**
The number of sample		481
first likelihood		-911.2176
last likelihood		-725.0952
		0.204
		0.191

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Analysis 2

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : 1. duration time 2. egress time 3. weekday or not 4. gender
Method of estimation : Multinomial Logit model

Calculation

$$U_{train} = V_1 + \varepsilon_1 = d_1(duration) + d_2(egress) + b_1 + \varepsilon_1$$
$$U_{car} = V_2 + \varepsilon_2 = d_1(duration) + d_3(weekday) + d_4(gender) + b_2 + \varepsilon_2$$
$$U_{walk\,or\,bike} = V_3 + \varepsilon_3 = d_1(duration) + \varepsilon_3$$

$$P_n(i) = \frac{\delta_{ni}\exp(\mu V_{ni})}{\sum_{j=1}^{3}\delta_{nj}\exp(\mu V_{nj})} \qquad i \in j = \{1,2,3\}$$

$$\{\delta_j : \text{mode abailability} \mid 1,0\}$$

Analysis 2

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : 1. duration time 2. living area 3. age 4. gender 5. cost
Method of estimation : Multinomial Logit model

Calculation result

	Parameters	t value	
Constant term for train	-9.41×10^{-1}	1.97	**
Constant term for car	-1.71	-2.24	**
Duration time(minutes)	-4.34×10^{-3}	1.77×10^{-2}	
Egress time(minutes)	-1.60×10^{-1}	-3.13	**
Day(weekday=1, weekend=0)	-3.05×10^{-2}	3.68×10^{-1}	
Gender(male=1, female=0)	1.98	3.05	**
Number of samples		196	
Initial likelihood		-160.27	
Final likelihood		-141.10	
Coefficient of determination		0.12	
Coefficient of determination(modified)		0.08	

Analysis 3

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : duration time
Method of estimation : Multinomial Logit model

Calculation

$$U_{train} = V_1 + \varepsilon_1 = d_1(duration)/100 + b_1 + \varepsilon_1$$
$$U_{car} = V_2 + \varepsilon_2 = d_1(duration)/100 + b_2 + \varepsilon_2$$
$$U_{walk\,or\,bike} = V_3 + \varepsilon_3 = d_1(duration)/200 + \varepsilon_3$$

$$P_n(i) = \frac{\delta_{ni}\exp(\mu V_{ni})}{\sum_{j=1}^{3}\delta_{nj}\exp(\mu V_{nj})} \qquad i \in j = \{1,2,3\}$$

$$\{\delta_j : \text{mode abailability} \mid 1,0\}$$

Analysis 3

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : duration time
Method of estimation : Multinomial Logit model

Calculation result of alone trip

	Parameters	t value	
Constant term for train	-2.08×10^{-1}	-1.01	
Constant term for car	-2.00	-9.42	**
Duration time(train:1/100minutes) Duration time(car:1/100minutes) Duration time(walk or bike:1/200minutes)	-8.27	-7.85	**
Number of samples		286	
Initial likelihood		-287.44	
Final likelihood		-174.15	
Coefficient of determination		0.39	
Coefficient of determination(modified)		0.38	

Analysis 3

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : duration time
Method of estimation : Multinomial Logit model

Calculation result of accompanied trip

	Parameters	t value	
Constant term for train	-4.56×10^{-1}	-1.84	
Constant term for car	-9.08×10^{-1}	-4.26	**
Duration time(train:1/100minutes) Duration time(car:1/100minutes) Duration time(walk or bike:1/200minutes)	-5.86	-5.71	**
Number of samples		195	
Initial likelihood		-198.94	
Final likelihood		-151.86	
Coefficient of determination		0.27	
Coefficient of determination(modified)		0.22	

Analysis 4

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : 1. duration time 2. living area 3. age 4. gender 5. cost
Method of estimation : Multinomial Logit model

Calculation

$$U_{train} = V_1 + \varepsilon_1 = d_1(dur) + d_2(liv)\times 10 + d_3(age) + d_4(gen)\times 10 + d_5(\cos) + b_1 + \varepsilon_1$$
$$U_{car} = V_2 + \varepsilon_2 = d_1(dur) + d_2(liv)\times 10 + d_3(age) + d_4(gen)\times 10 + d_5(\cos) + b_2 + \varepsilon_2$$
$$U_{worb} = V_3 + \varepsilon_3 = d_1(dur) + d_2(liv)\times 10 + d_3(age) + d_4(gen)\times 10 + \varepsilon_3$$

$$P_n(i) = \frac{\delta_{ni}\exp(\mu V_{ni})}{\sum_{j=1}^{3}\delta_{nj}\exp(\mu V_{nj})} \qquad i \in j = \{1,2,3\}$$

$$\{\delta_j : \text{mode abailability} \mid 1,0\}$$

Analysis 4

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : 1. duration time 2. living area 3. age 4. gender 5. cost
Method of estimation : Multinomial Logit model

	Parameters	t value	
Constant term for train	4.49×10^{-2}	1.81×10^{-1}	
Constant term for car	-1.09	-5.81	**
Duration time(minutes)	-6.86×10	-7.28	**
Living area(city=10, suburb=0)	5.51×10^{-11}	4.64×10^{-15}	
age	-2.53×10^{-10}	-2.70×10^{-11}	
Gender(male=10, female=0)	3.93×10^{-11}	8.33×10^{-12}	
cost(yen)	-2.28×10^{-1}	-4.31×10^{-1}	
Number of samples		278	
Initial likelihood		-285.14	
Final likelihood		-208.97	
Coefficient of determination		0.27	
Coefficient of determination(modified)		0.24	

Calculation result of alone trip

Analysis 4

Independent variable : choice of transportation means(train, car, walk or bike)
Dependent variable : 1. duration time 2. living area 3. age 4. gender 5. cost
Method of estimation : Multinomial Logit model

	Parameters	t value	
Constant term for train	1.18	1.61	**
Constant term for car	-8.62×10^{-1}	-2.08	**
Duration time(minutes)	5.51×10^{-2}	-3.90	**
Living area(city=10, suburb=0)	-4.23×10^{-12}	-1.78×10^{-16}	
age	7.02×10^{-12}	2.96×10^{-16}	
Gender(male=10, female=0)	4.11×10^{-12}	1.73×10^{-16}	
cost(yen)	-5.11×10^{-3}	2.01	**
Number of samples		72	
Initial likelihood		-75.45	
Final likelihood		-55.37	
Coefficient of determination		0.27	
Coefficient of determination(modified)		0.17	

Calculation result of accompanied trip

Discussion and Further Study

- Restrictions of examining each trip

Our goal was to make people using **private mode alone** change to use **public transportation** or use mode **with companions**.

But it was difficult to realize what the difference between alone-trip and together-trip.

For the future, we have to consider;

- relationship
- chain-trip
- family-structure
- Periodic activities(like lessons)
- How to work

etc....