利用者の交通手段選択に着目した集約型都市交通の評価

Evaluation of Intensive urban transportation focusing on the choice of public transport means

Team F

Behavior in Networks Studies Unit

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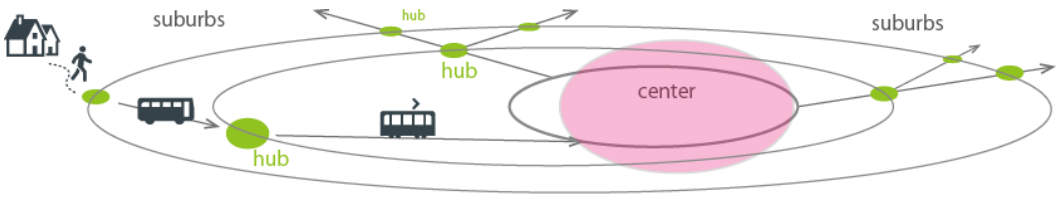
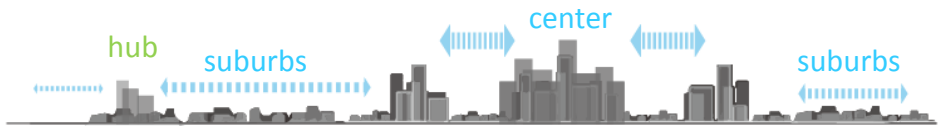
01. Background

> In intensive urbanization it is essential to satisfy the user needs for travel quality.

> Problems
costs, complex networks, aging society etc……..

> Find the most optimal route placement of public transport focusing on the choice of public transport means.
→ classify path into four types ; bus, bus-train, train-bus, train



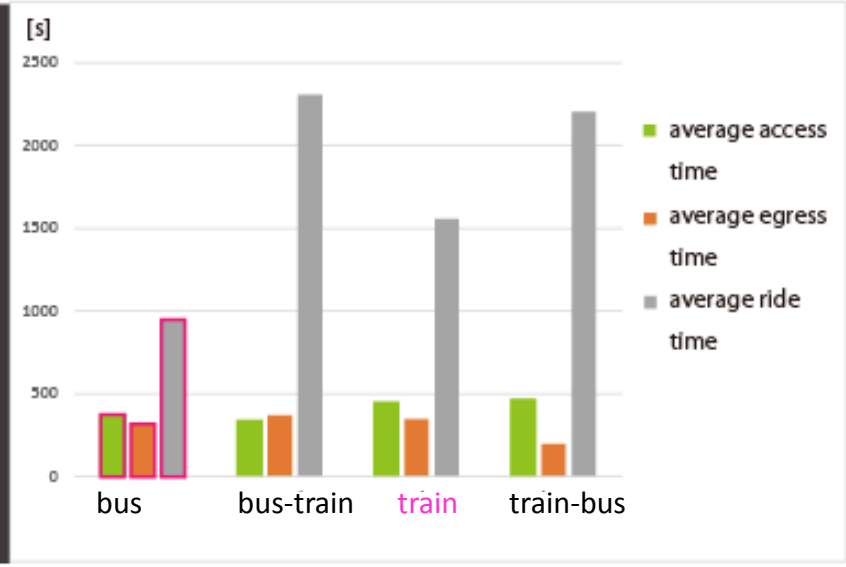


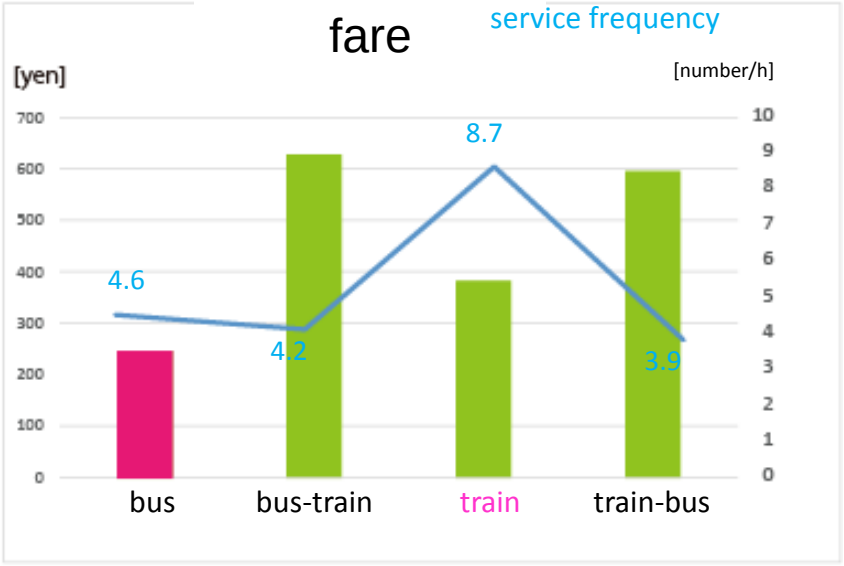
Basic analysis

The percentage of access/egress/ride time and cost for each actually selected choice

If users select “train”……

TRAIN





- access/egress/ride time of “bus” are lower than those of “train.”
  fare of “bus” is also lower than that of “train.”

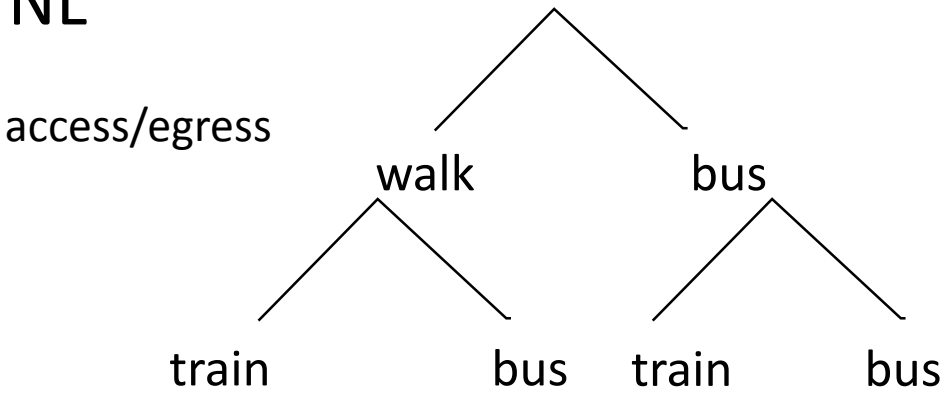
- there are some factors other than access/egress/ride time and trip costs

  ex. Service frequency

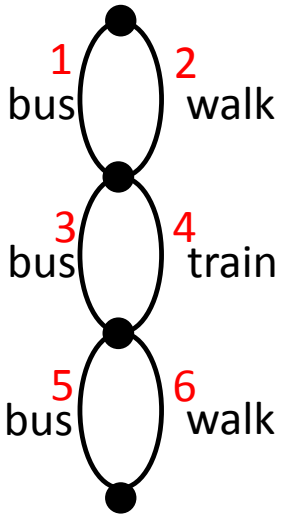
03. Model structure

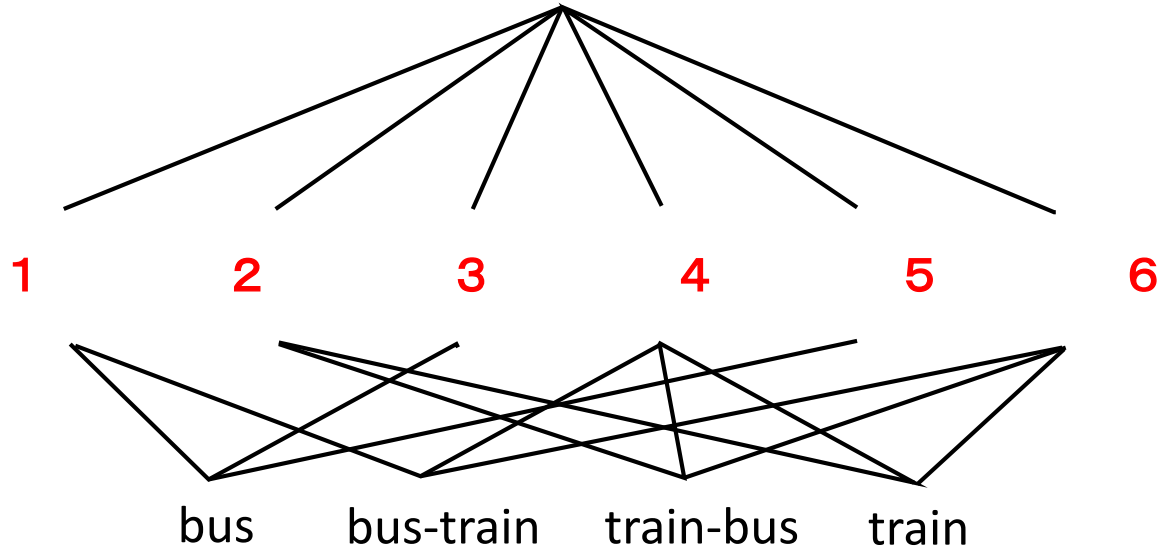
1. MNL

2. NL



3. CNL



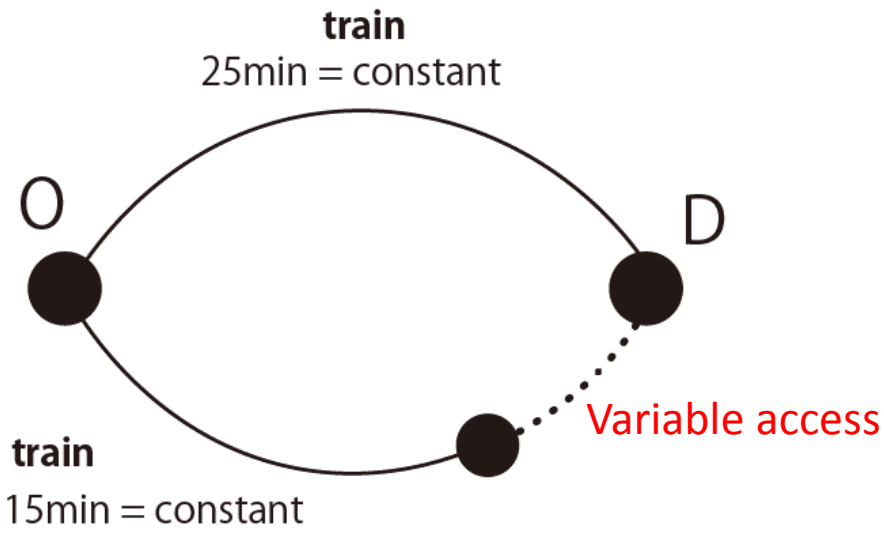


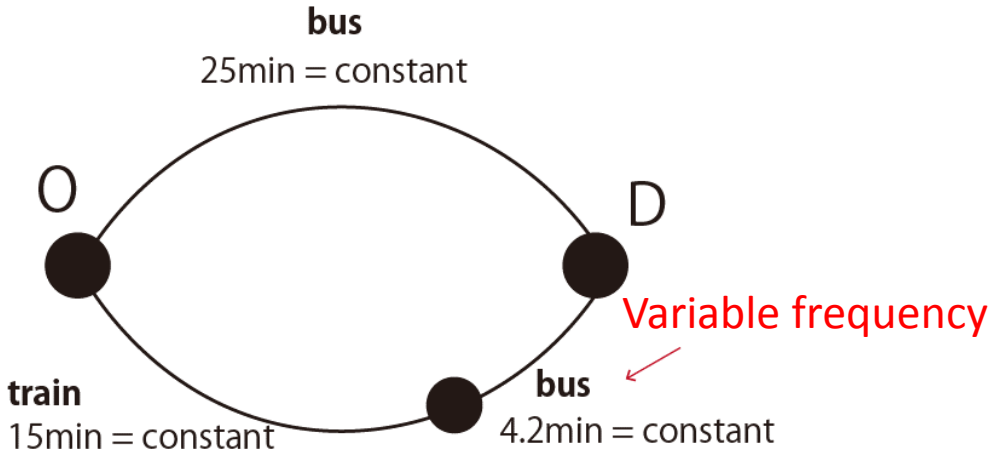
04. Estimation Results (MNL & NL & CNL)

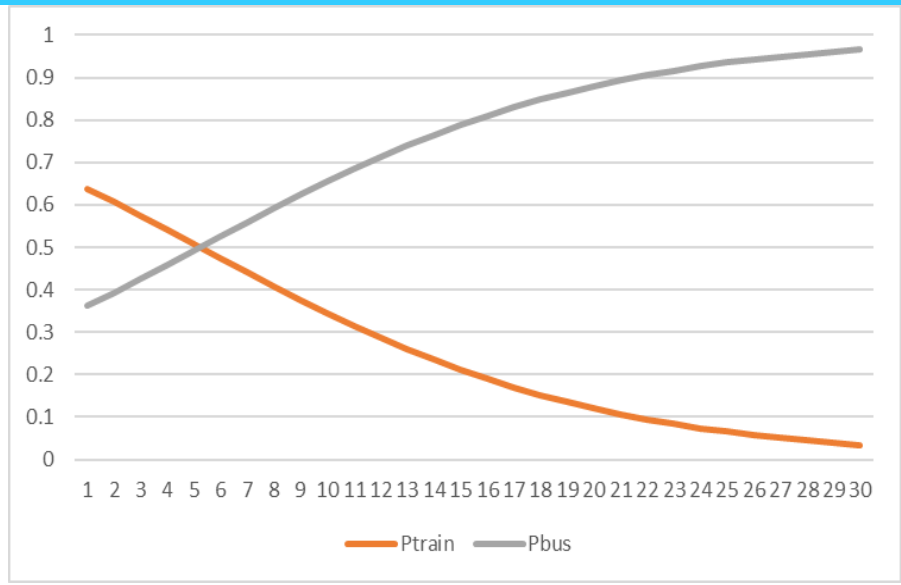
	MNL		NL		CNL	
	estimated parameter values	t-statistic	estimated parameter values	t-statistic	estimated parameter values	t-statistic
access time	-3.549	-5.94 **	-4.769	-4.40 **	-2.246	-4.58 **
egress time	-1.277	-1.77	-1.787	-1.81	-1.520	-2.64 **
ride time(train)	-0.752	-2.27 *	-0.790	-1.87	-0.146	-0.34
ride time(bus)					-0.949	-2.81 **
1st service frequency	0.195	4.46	0.280	3.54 **	0.167	3.73 **
fare	-3.696	-1.91	-5.736	-1.95	-0.026	-0.02
resistance to transfer	-2.407	-5.66 **	-3.805	-3.14 **	-2.208	-4.35 **
scale parameter			0.576	3.05 **	0.186	1.13
L(0)	-204.85		-205.17		-204.845	
LL	-100.74		-99.24		-83.044	
rho-square	0.51		0.52		0.595	
adjusted rho-square	0.48		0.48		0.556	
					significance	* 5% ** 1%

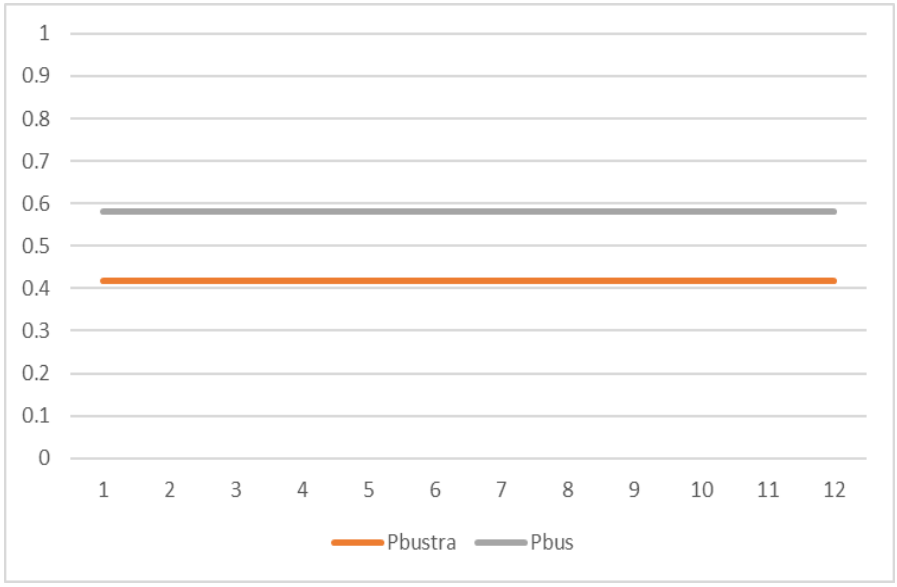
1) Parameters of Time & Fare & Transfer Resistance are negative (valid)
2) Parameters of Service frequency are positive(valid)
3) Scale parameters : NL= 0.576 , CNL=0.186(strong correlation)
4) Likelihood : -101(MNL)→-99(NL)→-83(CNL)

05. Numerical Analysis









06. Case study

■case2:hub & spokes

- Double the frequency of the existing bus bound for “Kamiooka” or “Isogo” (the price and the location of the bus stops is constant)
- propose the core bus connecting “Kamiooka” and “Isogo”(frequency:10 buses/h, fare:180 yen)
- Abolish some bus lines bound for neither “Kamiooka” nor “Isogo” in order to maintain operation cost

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07. Case study Methods & Result

■case1 : real state

■case2 : hub & spokes

[Methods]

1. Calculate utilities and probabilities using the parameters estimated by CNL
   →expected utility (EU) !
2. Multiply the expected utility by the number of OD
   →The sum of EU !

[Result]

The sum of EU

case1	-1757.407
case2	-1153.083

→case2 is better !

08. Suggestion

■Case Study（ケーススタディ）

Total utility of the region can be improved by enforcing intensive urban structure.

集約型都市構造を促進することで、地域内の総効用を改善することができる可能性がある

■Numerical Analysis（数値分析）

It is difficult to promote of intensive urban structure because transfer resistance is more critical than service frequency.

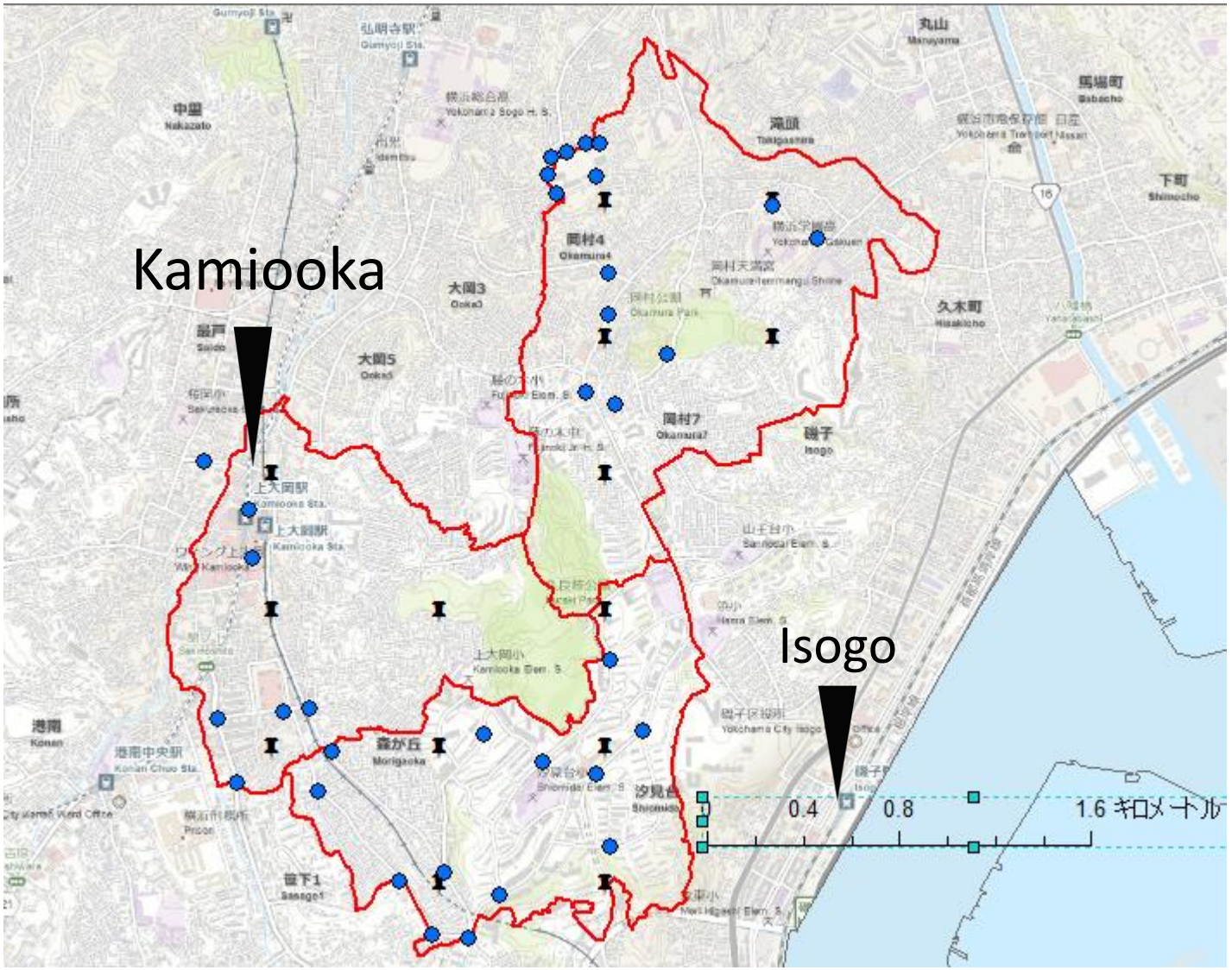
頻度を高くしてサービスレベルを上げても、実際には乗り換え抵抗の不効用が強く働き、集約型都市構造の促進は容易ではない

We should reconsider the location of bus stops because access and egress is very effective to actual mode choice.

アクセス・イグレスが強く効いているため、バス停配置から再考すべきである

Appendix

00. Case study Setting



00. Utility function

■Utility function

$U_{train} = V_1 + \varepsilon_1$

$= \theta_{a}*(\text{アクセス時間}) + \theta_{e}*(\text{イグレス時間}) + \theta_{r}*(\text{乗車時間}) + \theta_{f}*(\text{頻度}) + f*(\text{料金}) + b_1 + \varepsilon_1$

$U_{bus} = V_2 + \varepsilon_2$

$= \theta_{a}*(\text{アクセス時間}) + \theta_{e}*(\text{イグレス時間}) + \theta_{r}*(\text{乗車時間}) + \theta_{f}*(\text{頻度}) + f*(\text{料金}) + o*(\text{始発ダミー}) + b_2 + \varepsilon_2$

$U_{train\text{-}bus} = V_3 + \varepsilon_3$

$= \theta_{a}*(\text{アクセス時間}) + \theta_{e}*(\text{イグレス時間}) + \theta_{r}*(\text{乗車時間}) + \theta_{f}*(\text{頻度}) + f*(\text{料金}) + o*(\text{始発ダミー}) + b_3 + \varepsilon_3$

$U_{train\text{-}bus} = V_4 + \varepsilon_4$

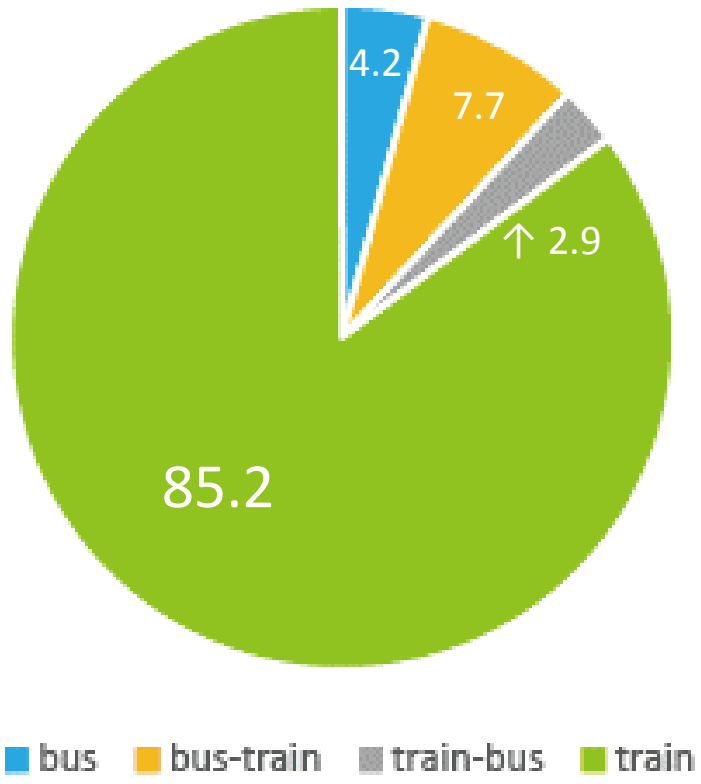
$= \theta_{a}*(\text{アクセス時間}) + \theta_{e}*(\text{イグレス時間}) + \theta_{r}*(\text{乗車時間}) + \theta_{f}*(\text{頻度}) + f*(\text{料金}) + o*(\text{始発ダミー}) + b_4 + \varepsilon_4$

$$P_n(i) = \frac{\delta_{ni} \exp(\mu V_{ni})}{\sum_{j=1}^{4} \delta_{nj} \exp(\mu V_{nj})}$$

$i \in j = \{1,2,3,4\}$

$\{\delta_j : \text{利用可能性} \mid 1,0\}$

00. Dataset



Extract data
: trip that have two or more choices

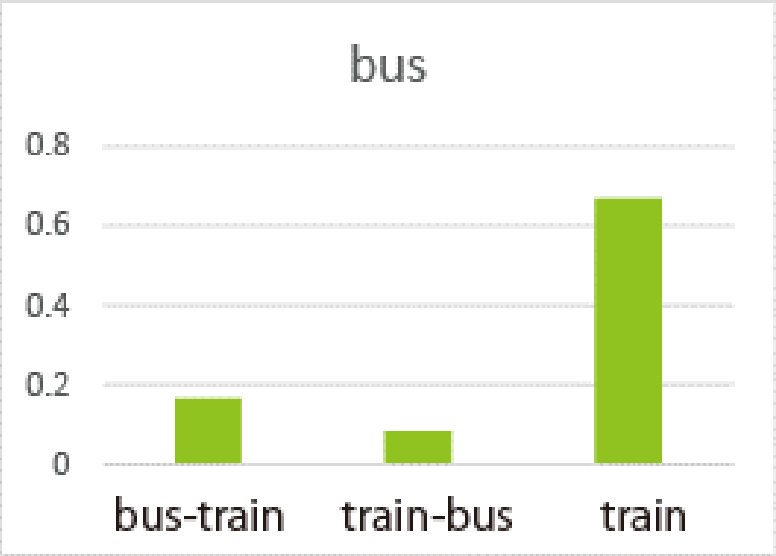
Total : 311 data (trip)

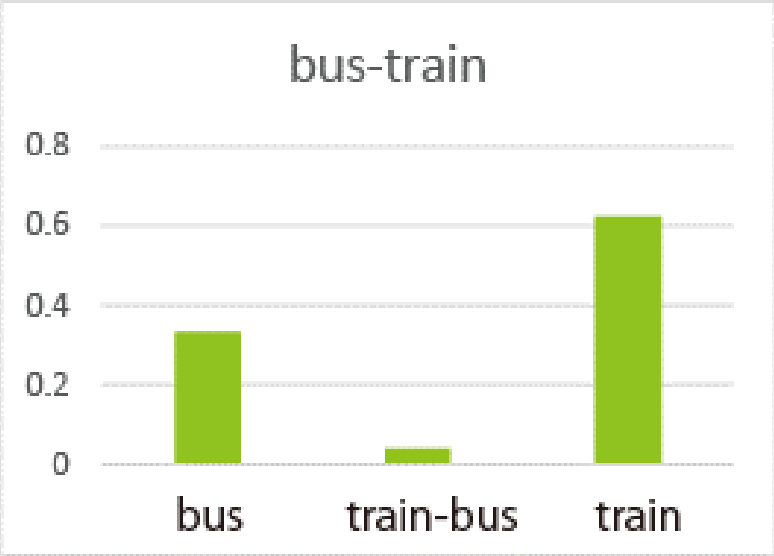
[explanatory values]

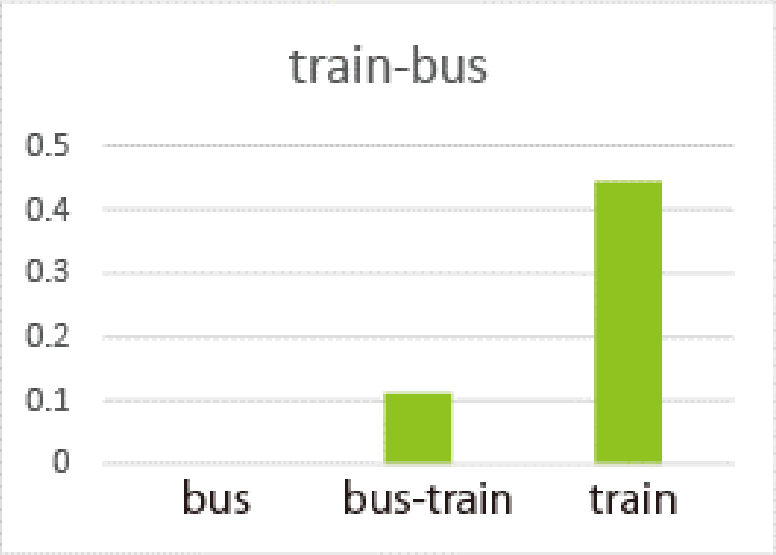
- dummy: first train
- access time
- egress time
- ride time
- survice frequency
- fare

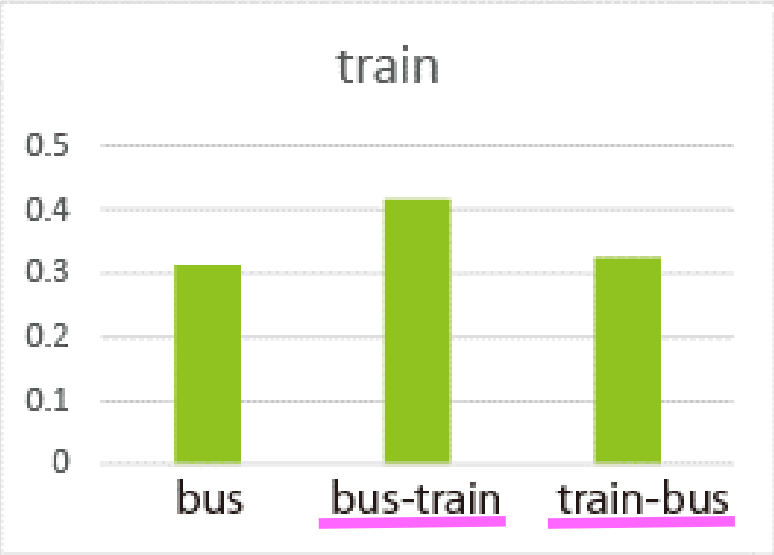
00. Basic analysis

The percentage of selectable means for each actually selecteθ choice





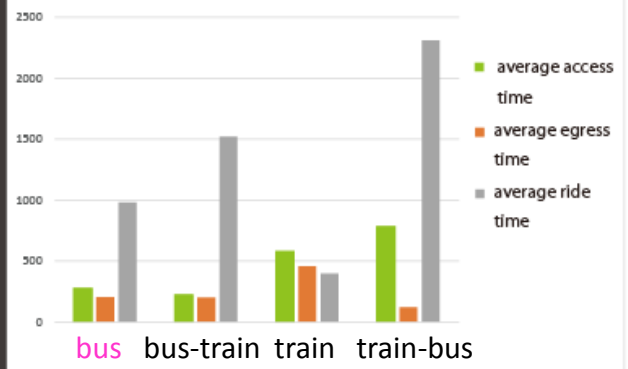


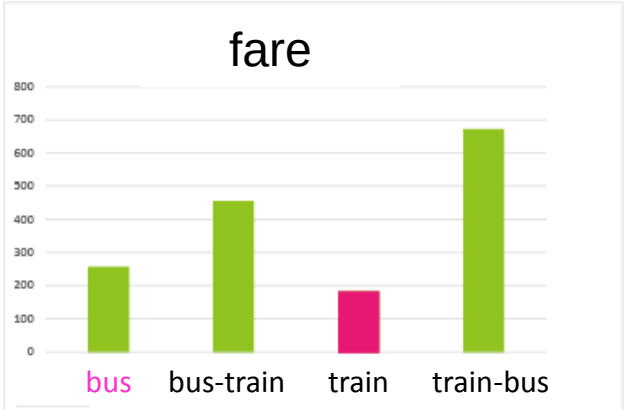


00. Basic analysis

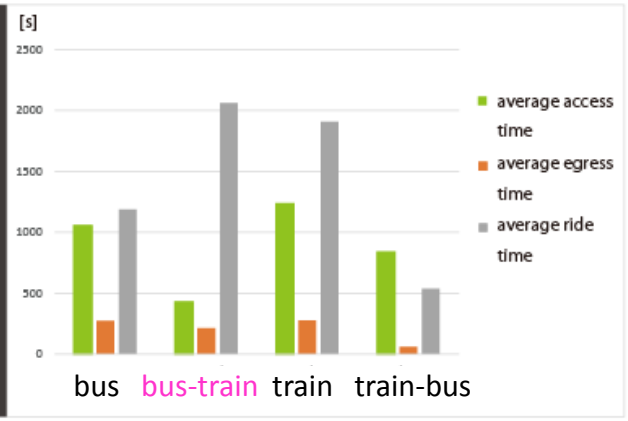
The percentage of access/egress/riθe time anθ cost for each actually selecteθ choice

BUS

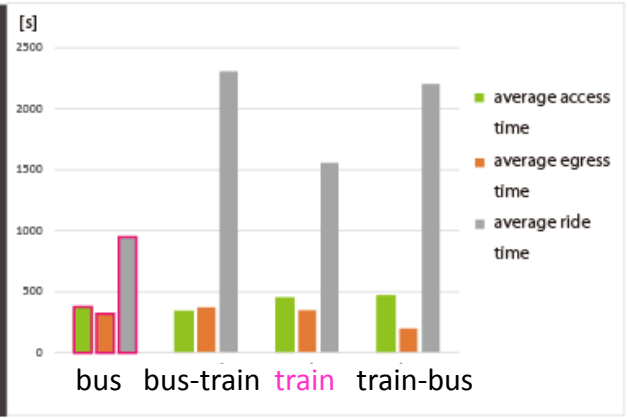


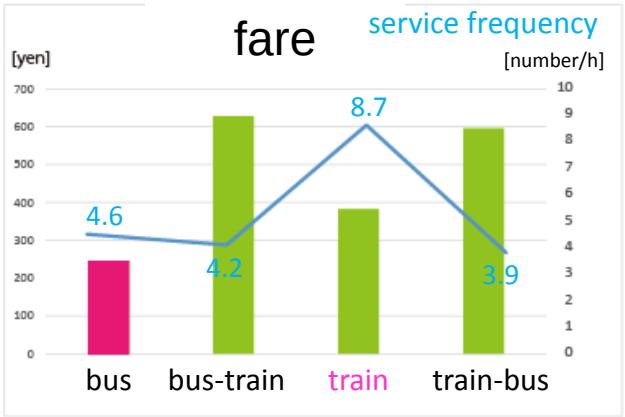


BUS-TRAIN



TRAIN





- access/egress time ≻ riθe time
  if the cost is a little expensive
- “bus” is more comfortable than “train”?

- access/egress time ≻ riθe time
  if the cost is a little expensive

- there are some factors other than access/egress/riθe time anθ trip costs

ex. Service frequency