IV-12 The Comparison and Estimation of Route choice models

愛媛大学大学院　学生員　○劉明微
愛媛大学工学部　正会員　羽藤英二

1 The Background of Study

The methods of discrete choice analysis in modeling of route choice behavior have proved particularly powerful both in general and in transportation.

In the discrete choice models, MNL is the simplest one, but because of the i.i.d property, there have limitations in it. In order to relieve the limitations, other models that consider overlapping of the route such as c-logit, nested logit, CNL, ECL, Logit kernel, and RPL have been provided.

2. Model Comparison

2.1 MNL

$$P_n = \frac{e^{V_n}}{\sum_{n'} e^{V_{n'}}}, \qquad V_n = \beta x_n \tag{1}$$

β :parameter needs to be estimated

x_n: the impedance.

The limitation is the assumption that error terms are independent and identically.

2.2 C-Logit

$$P_n = \frac{e^{V_n - cf_n}}{\sum_{p} e^{V_p - cf_p}} \tag{2}$$

$$CF_{in} = -\beta \ln \sum_{\alpha \in \Gamma_i} \frac{l_\alpha}{l_i} N_{\alpha n} \tag{3}$$

cf_n : the commonality factor.

L_{np} : length of route n and route n' have in common

L_n : length of path n

L_p : length of path n'

C-logit adds CF to route utilizes based on the amount of overlap with other routes.

2.3 Nested Logit

$$P_n = P_m P_{n|m} \tag{4}$$

$$P_m = \frac{(\sum_{n \in N_m} e^{V_{n'}/\mu_m})^{\mu_m}}{\sum_m (\sum_{n \in N_m} e^{V_{n'}/\mu_m})^{\mu_m}} \tag{5}$$

$$P_{n|m} = \frac{e^{V_n/\mu_m}}{\sum_{n \in N_m} e^{V_{n'}/\mu_m}} \tag{6}$$

μ_m: the dissimilarity parameter relating to nest m. similar alternatives are grouped together in nests.

2.4 CNL

$$p_n = P_m P_{n|m} \tag{7}$$

$$p_m = \frac{\sum_{n \in N_m} (\alpha_{n'm} e^{V_{n'}})^{1/\mu})^{\mu}}{\sum (\sum_{n \in N_m} (\alpha_{n'm} e^{V_{n'}})^{1/\mu})^{\mu}} \tag{8}$$

$$P_{n|m} = \frac{(\alpha_{mn} e^{V_n})^{1/\mu}}{\sum_{n \in N_m} (\alpha_{n'm} e^{V_{n'}}))^{1/\mu}} \tag{9}$$

$$\alpha_{nm} = (\frac{L_m}{L_n}) \delta_{nm} \tag{10}$$

μ : dissimilarity parameter

δ_{nm} equals 1 if link m is on route n and 0 otherwise. CNL is a link level model and similar alternatives are grouped together in nests.

2.5 ECL

$U_n = X_n \beta + T\zeta_n + \varepsilon$ ε is i.i.d distribution (11)

ζ_n: standard normal distribution.

$$L_n(\eta) = \frac{e^{(\beta X_n + T\zeta_n)}}{\sum_{n'} e^{(\beta X_{n'} + T\zeta_{n'})}} \tag{12}$$

$$P_n = \int L_n(\zeta) f(\zeta \mid \Omega) d\zeta \tag{13}$$

ECL is not characterized by the IIA property. Indeed complex patterns of route similarity can be specified through appropriate specification of f.

2.6 Logitkernel

$$\Lambda(i \mid \zeta) = \frac{\exp(x_i\beta + F_i T \zeta)}{\sum_j \exp(x_j\beta + F_j T \zeta)} \quad (14)$$

$$F = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \quad (15)$$

$$T = \alpha \begin{bmatrix} \sqrt{da} & 0 & 0 & 0 \\ 0 & \sqrt{db} & 0 & 0 \\ 0 & 0 & \sqrt{dc} & 0 \\ 0 & 0 & 0 & \sqrt{dd} \end{bmatrix} \quad (16)$$

Logitkernel is a link level model and is not characterized by the IIA property. Indeed complex types of route similarity can be specified through appropriate specification of f.

2.7 RPL

$$P_{ni} = \int \frac{e^{\beta' X_{ni}}}{\sum_j e^{\beta' X_{nj}}} f(\beta)\, d\beta \quad (17)$$

RPL is not characterized by the IIA property. Indeed complex patterns of route similarity can be specified through appropriate specification of f.

2.8 Comparison of GEV Models

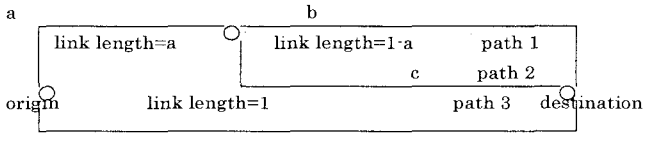

Figure 1: Network of the route

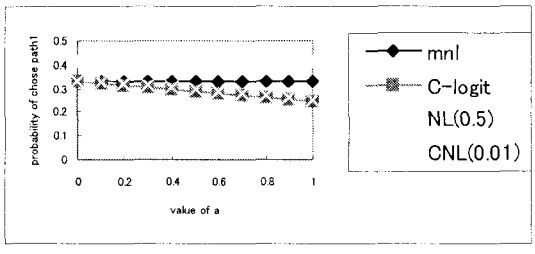

Figure 2: Comparison of GEV Models

3 Estimation research

3.1 Case Studies

The percent of the overlap between path1 and path 2 is greater than 50%, and the one between path 1 and path 3 is very small. Path1 is the route selected by the people.

3.2 Data

Table 1: data of the models

Goal	Impedance	Observation
Route Choice	Distance	111

3.3. Result

Table 2: Result of the models

MNL		
parameters	estimates	t-test
distance	0.3271	5.558
logliklihood	-121.946	
	-52.78	
C-logit		
parameters	estimates	
distance	0.3498	5.44
δ	-2.348	-1.998
logliklihood	-121.946	
	-50.524	
nestedlogit		
parameters	estimates	t-test
distance	0.2752	4.639
μ	0.8815	2.196
logliklihood	-121.946	
	-50.886	
CNL		
parameters	estimates	t-test
distance	0.3132	3.89
μ	0.8869	2.419
logliklihood	-121.946	
	-39.233	
ECL	draws=20000	
parameters	estimates	t-test
distance	0.5196	1.107
T	1.5717	5.608
logliklihood	-121.946	
	-52.694	
RPL	draws=20000	
parameters	estimates	t-test
distance	0.3271	5.558
stand.dev. β	0.0001	0.005
logliklihood	-121.946	
	-52.78	
logitkernel	draws=20000	
parameters	estimation	t-test
distance	0.3277	5.252
α	0.017	0.062
logitkernel	-121.946	
	-52.778	

4. Conclusion

The parameter of distance is '+' means that majority of travelers fail to minimize distance. CNL is the most suitable model in this study. Models that take account of the degree of overlap, such as specific variants of C-logit, and an extreme form of CNL, permit full responsiveness of the model to minor deviations. The logitkernel, ECL and RPL model don't appear very well.