CHOICE SET FORMATION FOR LAND-USE MICRO-SIMULATION

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ABSTRACT

The current research discusses the issues of choice set formation which are especially important when a land-use micro-simulation model is developed. A questionnaire survey was carried out and represents that many locators usually consider only two or three areas at most as alternatives in location choice. In addition, a trial of land-use micro-simulation indicates that both wide and small aggregation of zone do not always give the most accurate simulation results.
Keywords: Land Use Model, Micro-Simulation, Location Choice

INTRODUCTION

A location choice in a land-use micro-simulation model has tremendous number of alternatives which are one of the reasons that affects worse accuracy of estimation of parameters and results of simulation. This is because not only the unit of locaters is usually small such as each individual or household, but also the unit of zone is very small in a land-use micro-simulation. The problem about choice set formation was discussed in the field of a disaggregate choice model by many researches, but it may be severer in the field of a micro-simulation model which has more alternatives than the disaggregate model.

There are two issues about choice set formation in the field of location choice behaviour. One is simply an issue about the number of alternatives and how to restrict its number. The other is an issue about site aggregation and how to aggregate sites as alternatives whether these sites are near each other or not. These issues can be discussed from many points of view. For example, how far locators are able to know the information of each site, how accurate they are able to distinguish difference of the features of each similar site, availability of selection of sites, and, in addition, technically, data availability and so on.

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ISSUES ABOUT CHOICE SET FORMATION

A land use model has basically many location alternatives all over the area. The model developer usually divides areas into smaller zones in the main target area and into wider zones in the other area. In the outside of the area, framework of population and households are given and these areas are ignored as an alternative or aggregated into one wide zone. These methods arbitrarily form choice sets and assume that all alternatives are recognized by locators.

The authors *et.al.* formed choice sets with the alternative which is really selected by the locator and some ones which are randomly selected among other many alternatives by the researcher and estimated parameters. There are two types of random selection. One is direct selection from all over the area, and the other is like a choice based sampling by grouping zones from a certain point of view. However, each case assumes that random sampling is expected to give the right selection behaviour and therefore it is difficult to give any rational explanation for this method. Furthermore, this is faced with difficulty that nobody knows which zone an alternative selected would be corresponded with. The land-use micro-simulation requires other good method of choice set formation.

A researcher can form choice sets for some rational reasons. In a mode choice behaviour of a transportation model, for example, a mode of car is not given to a man who does not have any car-licence. In a location choice, an area with high land price would not be an option for a poor people or household, and an area without any public transportation service may not be an option for a household in which no member access any type of private vehicles. In other cases, a researcher directly asks each locator his/her choice sets imagined. This method has the merit that each choice set is expected to reflect each locator's needs and wants. However, some researcher argues that it is unreliable whether each locator can answer his/her right alternatives in the questionnaire.

Many alternatives primarily cause high similarity each other. The IIA is theoretically and positively discussed by many researchers in the transportation model. In a location choice model, extremely said, all zones are deferent each other. However, locator can consider some zones the same or similar and form choice sets with these zones. A threshold would be required for representing these behaviours from the cognitive psychology point of view.

CHOICE MODEL IN THE FIELD OF COGNITIVE PSYCHOLOGY

The cognitive psychology points out three important effects on consumers' choice behaviours, those are 'attractive effect', 'similarity effect' and 'compromise effect'. These three effects should be considered in a land-use micro-simulation model.

The 'attractive effect' is that an alternative "A' " which has very similar but relatively worse features to an alternative "A" rises attractiveness of "A" and as a result increases the share of

"A" in a market. The alternative "A' " is termed a decoy. In the case of location choice, a zone may have relatively high attractiveness if a zone is located near the zone and has similar but relatively worse land conditions even if some zones have more attractive land conditions but are far from the zone. When similar locators search similar houses in a similar period, this kind of effect will be observed.

The 'similarity effect' is that an alternative "S" which has similar attributes to "A" tends to encounter keener competition with "A" than "B" which has relatively different attributes. The nested Logit model can solve this kind of issue. However, in the location choice, few researchers positively investigate how to make groups with zones which have various land conditions and spatial auto-correlation each other. In a land-use micro-simulation model, each locator has various attributes and features and therefore process in which each locator forms choice set should be considered.

The 'compromise effect' is that an alternative which has extreme attributes does no tend to be selected and other alternative which has moderate ones be selected. A convex function of locator's utility can give a solution of this problem.

Roe(2001) develops a comprehensive model and explains these three effects in one equation model. In addition, Satomura(2008) represents that the higher effects are observed, the longer be the time of selection. Location choice behaviour should be considered this effects since it tends to take longer time.

THE NUMBER OF ALTERNATIVES IN LOCATION CHOICE

A questionnaire survey was carried out for location choices. Even though some researchers argue that questionnaire method may be unreliable whether each locator can answer his/her right alternatives, a positively research should be carried out for understanding the real choice behaviour in Japan. The target area was Nabari city which is located on the skirts of Kinki metropolitan area, the second large metropolitan area of Japan. The number of questionnaire sheets collected were 241 and the ratio was 17.2%. An index is defined;

Area factor index = (the number of households which select zone i and answer that a certain land condition is dominant for choice behaviour / the all number of households which select zone i) / (the number of households which answer that the land condition is dominant for choice behaviour / the all number of households)

Table I – The number of Alternatives in Location Choice

The number of Alternatives	Share
1 alternative	34 %
2 alternatives	47 %
3 alternatives	15 %
More	3%

Table 1 shows the number of alternatives locators directly answered. It represents that the number of alternatives are two or three at most when he/she considers the candidate for location. The number of zones was 20 in the target city. Each locators list up his/her candidate among approximately 20 zones.

The area factor index represents what kind of zones tend to be choice sets. The household which has the only one alternative as candidate for location choice answers what land condition is dominant. The conditions answered are good community and high accessibility to green areas. These are very special attributes for the limited zones. On the other hand, the household which has two or three alternatives as candidates for location choice answers that accessibility to work place, schools and shopping areas are dominant. These are common attributes among some areas in the target city. This results represents that land conditions are very important factors for formation of the choice set of location behaviour.

DATA ENTITIY AND SITE AGGREGATION

A trial of land-use micro-simulation is carried out. The model developed in Kitazume *et. al.* (2009) is introduced. The target area is the Sapporo Metropolitan Area which is one of the metropolitan area of Japan and consists of 322 small zones as candidates of location choice. Location choice patterns in 2005 are simulated based on the real location data in 2000 in the area. The simulation results in 2005 are compared with real location data then. The zones are aggregated in 6 cases showed in the Table 2. The simulations are carried out 30 times for the each case.

Table 2 – Site Aggregation

	Methods
2 zones	The main city and the others
3 zones	The CBD, the other area of the main city and the others
6 zones	Areas with 6 ranges of land price (by 2,000 yen)
19 zones	Municipalities
108 zones	Aggregate two or three the smallest zones
322 zones	The smallest zones

The purpose of these simulations is to seek the most adequate aggregation case to provide the most number of fitness of the zones.

Figure 1 shows the results of the simulation and the maximum, minimum and average fitness for each simulation case. The case of 108 zones is the result that the highest but the widest range of results are observed. This represents that both wide and small aggregation of zones do not always give the most accurate simulation results. The relationship between the size of zone and the range of data entity may affect the results.

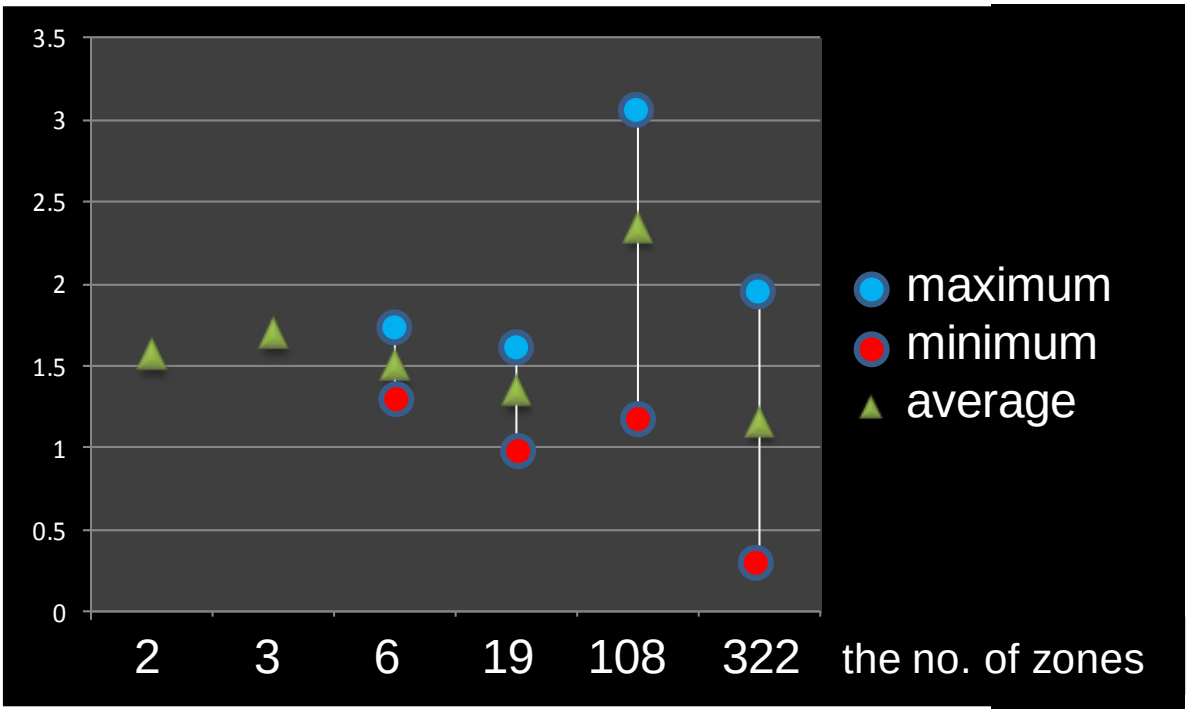

Figure 1 – Figure legend (Use Caption Figure style to insert the figure legend)

CONCLUDING REMARKS

The choice set formation for land-use micro simulation is discussed. In the field of transportation model and the Cognitive Psychology, some good ideas are proposed and also in the field of land-use micro-simulation, these ideas should positively discussed. This paper makes an questionnaire survey in a city of Kinki Metropolitan Area and the results represent that many locators usually consider only two or three areas at most as alternatives in location choice. In addition, a trial of land-use micro-simulation for Sapporo Metropolitan Area indicates that both wide and small aggregation of zone do not always give the most accurate simulation results.

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