STORE CHOICE PROBABILITIES IN REGIONAL SPACE BY THE DISCRETE CHOICE THEORY AND THE PROOF WITH CARD DATABASE OF STORES

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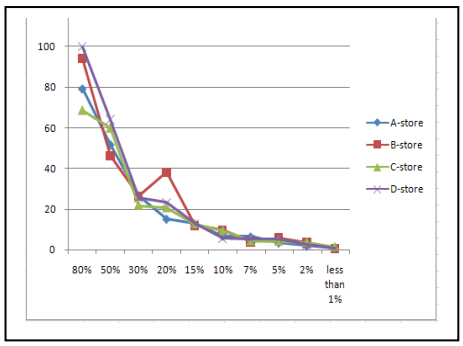
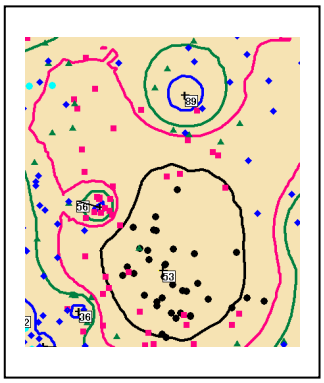
The problem is whether the choice probability of j store from the choice set at i statistical unit in regional space described by the Multi Nominal Logit model (MNL) would be proved with the j store's customer card database or not. Recently in the SM and GMS business the sales to card carrying customers account for 30~70 percent of stores' total sales. Defining a working card as a card which is used more than once a month, the number of a GMS store's working cards would be 10000~20000. The card database shows following buying features. ①Comparing stores, the larger the store the larger the trade area, however the larger the store the smaller the average monthly purchase per person is. The larger the distance between customers and store, the smaller the average monthly purchase per person is. These facts are contrary to the assumption of the so called "retail model" in the traditional geography, i.e. the constraint condition of origins. This model seeks to explain a store's total trips or sales under the constraint conditions, but these facts show that the model is unsuitable. If we take not sales but choice probability and customer numbers as explained variables we can show that the MNL explain the real chosen ratio of j-store at each i =Pr(i;j) which is estimated from the card database. This Pr(i;j) means the choice probability of j-store that each customer of i shopping more than once a month has chosen the store which brings him/her most utility at each shopping. This agrees with the definition of the MNL's probability formulated by D.McFadden(1974). We will replace consumers by an average person at any statistical unit and apply the MNL model. The function form of the MNL is exponential but we use Fechner's transformation to the function, so we get a power function for attractiveness and distance as below.

$$P(i:j) = A_j M_j \, R(i:j)^{-\lambda} / \Sigma_j A_j M_j \, R(i:j)^{-\lambda}$$

In this form we can say that if we assume M_j=sales space of j and A_j=relative sales per ㎡ then calculated P(i:j) mostly agree with the real choice probability Pr(i;j). The above power function has the same form as the "retail model" or the Huff model but the meaning is quite different. In the "retail model" constraint conditions of origins are essentially necessary to maximize the entropy, the meaning of probability is the distribution ratio of origins, i.e. budget of purchase. But in the MNL model the meaning is just choice probability and the constraint conditions of origins are not necessary. When applying the MNL the most important thing is to identify the choice set of consumers at i unit, i.e. the set which extends within the I.I.A.(Independent from Irrelevant Alternatives) property. The method of identifying is to compare the calculated and real choice probability on a map and a graph, replacing stores in the set.





Conclusion:

1. On the choice problem of SM&GMS stores in a region the attractiveness of the MNL model is "substance", not "function". If we assume attractiveness=(sales space of j)＊(relative sales per ㎡), then theoretical choice probabilities quite agree with the real probabilities obtained from the card database.

2. The functional model of attractiveness taking sales as explained values cannot explain real consumer behavior as argued in our last paper(H. Nagatsuka &K. Nakagawa 2006).

3. Until now it has been impossible to identify the choice set that satisfies I.I.A. property. Now we can identify if using the card database and the MNL. In the case of the SM&GMS choice set GMS is chosen comparing GMS and SM it's sales space is over about 2500 ㎡. Their merchandise is not parallel but a consumer who resides near a large SM store would not choose a GMS store far away. Smaller supermarkets would make up the choice set themselves. 4. Choice does not link itself to purchase at a store. Purchasing habits cannot be described by any model. This is because purchasing depends on the distance between consumer and a store, and also on the distribution of stores which are not in the choice set.

5. There are at least two types of retail spatial competition. One is strong competition which can be described by the MNL, another is weak competition which cannot be described by the MNL but which can influence the sum of purchases at each a store .

6. Traditional geography insists that the MNL supports Wilson's spatial interaction model because of the same form of function, but it's a logical mistake.

7. The disposition of centers of commerce could not be formed form nonlinear interaction between stores self-organizationally. Centers are planned by entrepreneurs and the behavior could not be described by any model. But the choice of consumers can be described by the discrete choice theory. The retail spatial market is statistically a stable world.

Keywords

Choice problem in regional space, Multi Nominal Logit model, Card database of stores, Choice set within I.I.A. property, Two types of retail spatial competition

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