How to Aggregate Individual Preferences into Group Choice?  
- A Series of Modeling Comparisons Based on Stated Preference Survey -

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ABSTRACT  
Group choice survey and modeling methods, especially in the context of household decision, have been  
attracted more and more attentions in transportation. Up to now, two relevant special issues have been  
published\(^1,2\). The papers included in these two special issues have mainly focused on modeling  
approaches, such as utility-based modeling, latent class modeling, rule-based modeling, and micro-  
simulation approaches. The topics have covered household task and time allocation, car ownership,  
mode choice, activity generation/participation, and scheduling behavior.

Review of the existing studies suggests that there are only limited studies dealing with intra-household  
interaction from the perspective of survey method, and as a result, most of the existing models have  
been built upon some normative behavior assumptions, drawn on from other disciplines. There is  
another issue that has not been satisfactorily examined, i.e., how to aggregate individual preferences  
into group choice. The existing studies have shown how to aggregate the group members’ utilities  
(preferences) into the group utility (preference). However, to make a joint decision, the group members  
might make the negotiation with each other at the decision outcome level (i.e., choice results), rather  
than at the preference level. In such case, it is necessary to figure out how to calculate the group choice  
probability based on members’ independent choice probabilities. In addition, such aggregation could  
become problematic depending on whether group decision occurs at the attribute level or at the  
alternative level. Existing studies have assumed that group members make a negotiation with respect to  
the total utility of the alternative. In reality, group members may make the negotiation only focusing on  
some specific attributes of an alternative in choice set. The attribute-based modeling approach should  
be also developed and compared with the existing alternative-based models.

Under such circumstances, this study attempts to apply a stated preference survey method to explore  
how to aggregate individual preferences into group choice behavior. Considering the important role  
played by transit-oriented development in realizing environmentally sustainable transport society, this  
study deals with households’ transit-oriented residential choice behaviors. One relevant existing study  
was done in the early 1990s by Timmermans and his colleagues\(^3,4\), who investigated a couple’s  
residential choice behavior based on hierarchical information integration (HII) theory, which is one type  
of stated preference (SP) approaches. HII theory adopts a two-stage survey method. At the first stage,  
attributes influencing residential choice are classified into some major categories. The couple is required  
to separately evaluate the influences of major categories and their original attributes on residential  
choice behavior, respectively. After that, influence scores of original attributes under each major  
category are calculated based on some statistical methods. At the second stage, the couple is asked to  
jointly choose one of alternatives in choice set based on the scores of major categories obtained at the  
first stage. To incorporate the two members’ preferences, they introduced an additive-type household  
utility. The advantage of their approach is its ease of implementing the survey at each stage. However,  
the couple’s evaluations of attributes at the first stage might change depending on the choice alternatives  
shown in the second stage. As argued by Zhang et al. (2004)\(^5\), the utility of an alternative might change  
with the existence of other alternatives in choice set. In other words, evaluations of the attributes of the  
alternative might change with the shown alternatives.

To overcome the shortcoming of the HII-based survey method, selecting the households with only  
couples, the stated preference (SP) survey in this study first ask the husband and wife to answer the SP  
questions separately and then ask them to jointly answer the questions. The SP survey includes five  
alternatives: one is current residential location, and other four alternatives are combination of two
residential areas and two commuting modes (car and transit system). The attributes of the alternatives are combined based on an orthogonal fraction of factorial (OFF) design and they are shown to the respondents together with choice set. Each residential area is designed to have a high-rise condominium, which is characterized with house price, distances to major urban facilities including school, hospital, supermarket, and transit station. The assumed residential areas are all located nearby stations of a transit system: one is close (6km) to and another is far (12km) from city center. Commuting modes are only for the household head (mainly husband). Travel time and cost to the city center and parking fee at city center are selected as car service levels, which are altered in the survey, and service levels of the transit system are fixed at its current values. The OFF design results in 20 valid SP profiles and each respondent is randomly assigned to answer 4 SP profiles out of the 20 profiles. Thus, the SP data collected include each member’s and household’s choice results. The survey was a web-based survey, conducted in Hiroshima metropolitan area in 2005 with the help of an Internet-based survey company. As a result, 173 households gave complete answers to the questionnaires. It is found that members in about 40% of the households changed their stated choices after joint decisions.

By making full use of the above-obtained SP data, this study will analyze how individual judgments (preferences and choices) influence group choice with respect to 12 scenarios shown in Table 1. Our previous studies already developed the alternative-based group choice model. This study will develop an attribute-based choice model to aggregate individual preferences over each attribute, where the concept of generalized mean will be utilized. The fundamental model structure is adopted from logit model family. The probability-based models will be drawn on from other disciplines such marketing and social choice theories, including weighted linear model, weighted probability model, minimum endorsement model, and preference perturbation model. All these models are still under estimation. Trials and errors will be repeated to figure out which model structures are more suitable for the analyses in this study. Through such comprehensive analysis, it is expected to provide analysts with a much clearer picture about how to aggregate individual preferences into group choice.

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