A Study of Discrete Choice Model with Latent Variables for Apartment Selection

Motivations of the study
- Many researchers have been attempting to develop a variety of logit models in describing housing choice
- Traditional residential choice models depend solely on observed dwelling attributes and household’s socio-demographic information
- Logically, people’s perceptions on residential neighborhood do have effects on the housing decisions. However, relatively little attention has been directed to integrate latent variables in residential choice models

Objectives
- Introduce latent variables in residential choice models in order to provide a more realistic behavior representation of consumer’s housing choice
- To stress the importance of the cognitive processes on choice behavior, specifically the perceptions of residential satisfaction
- Identify the significant factors, such as housing attributes and consumer residential satisfaction, affecting the apartment purchase decision
- Understand consumer’s needs in future planning and developing housing estates

Nested Logit Model
- Nested logit model is appropriate when the set of alternatives faced by a decision maker can be partitioned into subsets, called nests
- The choice probability under nested framework presumes the decision process to have a hierarchical structure
- With the decomposition of utility, the nested logit probability can be expressed in terms of the product of two logit probabilities

\[ P_{ij} = P_{oni} P_{ni} \]

where

\[ P_{oni} = \frac{e^{\lambda_i}}{\sum_{k=1}^{K_i} e^{\lambda_k}} \]

\[ P_{ni} = \frac{e^{\lambda_i}}{\sum_{k=1}^{K_i} e^{\lambda_k}} \]

\[ \lambda_i = \ln \sum_{k=1}^{K_i} e^{\lambda_k} \] is the inclusive value

McFadden’s Sampling Rule
- When the number of alternative available for consumers to choose is immense, McFadden (1978) proposes a sampling rule for creating a reduced choice set to make data collection and estimation problem practically tractable and can still yield consistent parameter estimates

Reduced Choice Subset = The chosen alternatives + Some randomly selected non-chosen alternatives

Empirical Application of Residential Choice Model
- Data Description
  - The data is collected by using probability proportional to size (PPS) sampling method from three newly developed estates in Tseung Kwan O
  - 317 decision makers are interviewed

<table>
<thead>
<tr>
<th>Estates</th>
<th>Number of observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean Shore</td>
<td>122</td>
</tr>
<tr>
<td>Oscar by The Sea</td>
<td>117</td>
</tr>
<tr>
<td>Park Central</td>
<td>78</td>
</tr>
<tr>
<td>Total</td>
<td>317</td>
</tr>
</tbody>
</table>

- Estimation of Fitted Latent Variables
  - Perform Principal Axis Factoring on a set of indicators concerning consumer’s perception of residential satisfaction
  - Six factors are obtained:
    F1-Transportation Route Coverage
    F2-Estate Planning
    F3-Apartment Interior Design
    F4-Domestic Equipment
    F5-School Network
    F6-Community Facilities
- McFadden’s (1978) Sampling Rule
  - The opportunity set composed of the chosen alternatives and 59 randomly selected alternatives with equal probability

Integration of Latent Variables in Discrete Choice Models

![Diagram of Structural Equation Modeling]

- Explanatory Variables
- Latent Variables
- Indicators
- Utility
- Choice

- Interpretation of Parameter Estimates
  - Most of the estimates are found to be statistically significant, including the unit price of flat, flat size per person, view from window, floor level etc.
  - The latent variables measuring perception of residential satisfaction are observed having large impact on the residential choice
  - The residential Model with the incorporation of latent variables significantly improves the goodness of fit of the model