Choice with multiple alternatives

Specification of the deterministic part

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Introduction to choice models

ÉCOLE POLYTECHNIQUE
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Qualitative explanatory variables

Qualitative attributes

Examples

- Level of comfort for the train
- Reliability of the bus
- Color
- Shape
- etc...

Modeling

Identify all possible levels of the variable

- Very comfortable,
- Comfortable,
- Rather comfortable,
- Not comfortable.

Select a base level

- <u>Very comfortable</u>,
- Comfortable,
- Rather comfortable,
- Not comfortable.

Modeling

Introduce a 0/1 attribute for all levels except the base case

- z_c for comfortable
- z_{rc} for rather comfortable
- z_{nc} for not comfortable

	z_c	z_{rc}	z_{nc}
very comfortable	0	0	0
comfortable	1	0	0
rather comfortable	0	1	0
not comfortable	0	0	1

If a qualitative attribute has K levels, we introduce $K-1$ binary variables (0/1) in the model

Modeling

Utility function

$$V_{in} = \beta_{\mathrm{c}} z_{\mathrm{c}} + \beta_{\mathrm{rc}} z_{\mathrm{rc}} + \beta_{\mathrm{nc}} z_{\mathrm{nc}} + \cdots$$

Note

The choice of the base level is arbitrary.

Qualitative characteristics

Examples

- Sex
- Education
- Professional status
- etc.

Modeling heterogeneity

Behavioral assumption

- Individuals have different taste parameters.
- The difference is explained by a qualitative socio-economic characteristic.

$$V_{in} = \beta_{1n} z_{in} + \cdots$$

where

$$\beta_{1n} = \beta_{1n}(\text{education}_n).$$

Modeling heterogeneity

Segmentation

- Assume that there are K levels for the qualitative variable (e.g. education).
- They characterize K segments in the population.
- Define
$$\delta_{kn} = \begin{cases} 1 & \text{if individual } n \text{ is associated with level } k \\ 0 & \text{otherwise} \end{cases}$$
- Introduce a parameter β_1^k for each level and define

$$\beta_{1n} = \sum_{k=1}^{K} \beta_1^k \delta_{kn}$$

Modeling heterogeneity

Segmentation

$$V_{in} = \beta_{1n} z_{in} + \cdots = \sum_{k=1}^{K} \beta_1^k \delta_{kn} z_{in} + \cdots = \sum_{k=1}^{K} \beta_1^k x_{ink} + \cdots$$

where

$$x_{ink} = \delta_{kn} z_{in}$$

Segmentation with several variables

Example

- Gender (M,F)
- House location (metro, suburb, perimeter areas)
- 6 segments: (M, m), (M, s), (M, p), (F, m), (F, s), (F, p).

Segmentation

Specification

$$\begin{aligned}&\beta_{M,m} TT_{M,m} + \beta_{M,s} TT_{M,s} + \beta_{M,p} TT_{M,p} + \\ &\beta_{F,m} TT_{F,m} + \beta_{F,s} TT_{F,s} + \beta_{F,p} TT_{F,p} +\end{aligned}$$

$TT_i = TT$ if indiv. belongs to segment i, and 0 otherwise

Remarks

- For a given individual, exactly one of these terms is non zero.
- The number of segments grows exponentially with the number of variables.