

CHOICE MODELING IN R

CLASS 7B

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CHOICE MODELING

MIXED LOGIT

MIXED LOGIT

Using MXL model has implications for the welfare analysis

- As coefficients are now random, we cannot simply calculate WTP as their ratio
- Utility is given by $U_{ij} = \beta_i \mathbf{X}_{ij} - \alpha_i \text{Cost}_{ij} + \varepsilon_{ij}$
- So WTP is also a random variable:

$$WTP_{ik} = \frac{\beta_{ik}}{\alpha_i}$$

- We can only say something about characteristics of this distribution, e.g. mean, median etc.
 - We need to make sure that these are well defined
 - Usually calculated through simulation

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Let's go to  

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Example:

- If we want to generate correlated draws we usually use multivariate normal distribution. Let say we want to have 3 correlated vectors of draws. We first generate three independent vectors of draws from standard normal distribution $D_{i1}^r, D_{i2}^r, D_{i3}^r, \sim N(0,1)$
- We can then create correlated draws in following way

$$\begin{cases} \beta_{i1}^r = \mu_1 + \sigma_1 D_{i1}^r \\ \beta_{i2}^r = \mu_2 + \rho_{12} D_{i1}^r + \sigma_2 D_{i2}^r \\ \beta_{i3}^r = \mu_3 + \rho_{13} D_{i1}^r + \rho_{23} D_{i2}^r + \sigma_3 D_{i3}^r \end{cases}$$

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Example (continued):

- Written in vector form: $\boldsymbol{\beta}_i^r = \boldsymbol{\mu} + \boldsymbol{\Gamma} \cdot \mathbf{D}_i^r$
- Where

$$\boldsymbol{\Gamma} = \begin{bmatrix} \sigma_1 & 0 & 0 \\ \rho_{12} & \sigma_2 & 0 \\ \rho_{13} & \rho_{23} & \sigma_3 \end{bmatrix}$$

- It can be demonstrated that $\boldsymbol{\Sigma} = \boldsymbol{\Gamma} \cdot \boldsymbol{\Gamma}'$ is a covariance matrix, so that $\boldsymbol{\beta}_i^r \sim MVN(\boldsymbol{\mu}, \boldsymbol{\Sigma})$

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Controlling for correlations is important and often significantly improves model fit

- Correlation of tastes
- Scale heterogeneity / heteroskedasticity
- Single attribute being coded as multiple variables

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MIXED LOGIT — WTP-SPACE

MXL can be estimated in the so called WTP-space, where coefficients can be directly interpreted in monetary terms

- There is no need for simulations after the estimation
- Optimization could be more difficult because model is more non-linear

We can specify utility function as

$$U_{ij} = \boldsymbol{\beta}_i \mathbf{X}_{ij} - \alpha_i \text{Fee}_{ij} + \varepsilon_{ij} = \alpha_i \left(\frac{\boldsymbol{\beta}_i}{\alpha_i} \mathbf{X}_{ij} - \text{Fee}_{ij} \right) + \varepsilon_{ij} = \alpha_i \left(\boldsymbol{\lambda}_i \mathbf{X}_{ij} - \text{Fee}_{ij} \right) + \varepsilon_{ij}$$

Instead of assuming some distribution for $\boldsymbol{\beta}_i, \alpha_i$, we assume one for $\boldsymbol{\lambda}_i, \alpha_i$

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Instead of assuming so

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ADDING COVARIATES

Similarly as in MNL, we may often want to individual-specific covariates into the model

- For example, age, gender etc.
- Basically, to control observed preference heterogeneity

In MXL they can enter the model analogously as in MNL

- E.g., interactions with attributes
- Their coefficients are usually not random

ADDING COVARIATES

Most often, such covariates enter through random parameters

- For normal distribution this is the same as in MNL (so-called mean-shifters)

$$\beta_i = \mu + \lambda Z_i + \sigma \xi_i$$

- For log-normal distribution it can enter under the exponent:
 - This assures that coefficient is always positive/negative

$$\beta_i = \exp(\mu + \lambda Z_i + \sigma \xi_i)$$

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