Advanced Mathematical Methods for Infrastructure and Transportation Planning

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- To study the theory and the applications of "Discrete Choice Model (DCM, 離散選択モデル)", which is one of the most popular method for travel demand forecasting.
 - Theoretical Basis: Microeconomics, Applied Statistics, Optimization Theory, Simulation
 - Applications: Predicting shares in travel demand or other market, Economic evaluation of transport infrastructures
- To learn about some practical issues of DCM through several exercises and assignments (Model estimation with some dataset).
 - "BIOGEME": Free software for estimation and simulation of DCM
 - Computer Labs. with dataset from various research field such as "transportation", "telecommunication", "energy" and "marketing".

Applications of DCM



Applications of DCM

- Most of early studies deal with individuals' "Mode choice".
 - McFadden (1974): Seminal paper
 - Domencich and McFadden (1975): Forecasting the passenger demand of Bay Area Rapid Transit (San Francisco)
- Other applications (mainly the works by the professors at TokyoTech)
 - Recreation demand (Hausman et al. 1995, Fukuda and Morichi 1999)
 - Telephone-service choice (Train et al. 1987)
 - Occupation (job) choice (Schmidt and Strauss 1975)
 - Trip destination choice (Yai 1985)
 - Railway route choice for Tokyo Network (Yai et al. 1997)
 - Choice of a daily activity pattern (Fujii 1997)
 - Car-parking choice (Muromachi 1993)
 - Analysis of illegal-bicycle-parking (Fukuda 2004)
 - Pedestrian behavior (Antonini et al. 2006)
- Other interesting applications: Facial expressions, Selection of supporting political party, etc.



References for Your Study

- Ben-Akiva, M. & Lerman, S. (1985) Discrete Choice Analysis: Theory and Applications to Travel Demand, MIT Press.
- Train, K. (2003) Discrete Choice Methods with Simulation, Cambridge University Press.
- ▶ 北村他 (2002) 交通行動の分析とモデリング, 技報堂出版.
- ▶ 土木学会 [編] (1996) 非集計行動モデルの理論と応用, 土木学会.
- Supplemental readings will be distributed at OCWi if necessary.

- 1. (April 7) Choice Behavior and Binary Choice Models (BCM)
- 2. (April 21) Estimation of BCM
- 3. (April 28) Computer Lab. (1): Estimation of BCM
- 4. (May 7) Multinomial Choice Models: Logit and Probit
- (May 12) Specification and Estimation of Multinomial Logit Models (MNL)
- 6. (May 19) Computer Lab. (2): Estimation of MNL
- 7. (May 26) Statistical Tests of Discrete Choice Models
- 8. (June 2) Independent from Irrelevant Alternatives, Forecasting and Microsimulation
- 9. (June 9) Computer Lab. (3): Statistical Testing & Forecasting
- 10. (June 16) Nested Logit Model (NL)
- 11. (June 23) Issues on Sampling
- 12. (June 30) Computer Lab. (4): NL & Sampling Issues
- 13. (July 7) Mixed Logit Model (MXL) & Simulation-based Estimation
- 14. (July 14) Application of DCM in Transportation and *Computer Lab. (5)*: Estimation of MXL

- Class participation
- Five assignments (corresponding five exercises)
 - Estimation of DCM, programming and forecasting market shares
 - The "BIOGEME" will be used in all exercises and assignments. The website of BIOGEME: http://biogeme.epfl.ch
 - Interpretation, discussion & new suggestions with your estimation results
- > You may write assignments either in English or in Japanese.
- Students are required to bring a laptop PC for those five exercises.
- All lecture materials have already been uploaded on TITECH OCW-i (https://secure.ocw.titech.ac.jp/ocwi/). Students are required to print them out and bring them to each class.
- Exercise materials have also been uploaded. Students are required to download and save them into your PC in advance.