

Mathematical Modeling of Individual Choice Behavior

(選択行動の数理モデル)

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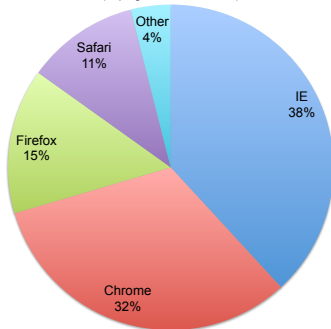
Motivation of this Course

Individuals Choices (Decision-making)



Aggregate Output (Market Demand/Share)

Market share of Web Browsers in Japan
(<http://gs.statcounter.com/>)



Motivation of this Course

Human dimension in

- Engineering
- Planning
- Marketing
- Business
- Policy-making

Need for

- Behavioral theories
- Quantitative methods
- Mathematical models
- Computing (free) softwares

Aims and Scopes

- To study the theory of “Discrete Choice Model (DCM, 離散選択モデル)”, which is one of the most popular method of market demand analysis.
 - **Theoretical Basis:** Microeconomics, Applied Statistics, Optimization Theory, Simulation
 - **Applications:** Predicting future demand in transportation or other markets, Economic evaluation of transport infrastructures
- To learn knowledge on practical applications of DCM through some exercises and assignments (model estimations with some dataset).
 - “BIOGEME”: Free software for estimation and simulation
 - Computer laboratories with the dataset from various research field such as “transportation”, “telecommunication”, “energy” and “marketing”.

- Most of early studies deal with individual **mode choice**.
 - McFadden (1974): Seminal paper
 - Domencich and McFadden (1975): Forecasting the passenger demand for Bay Area Rapid Transit (BART) in San Francisco.
- Other applications include:
 - **Trip destination** choice (Yai 1985)
 - **Recreation demand** (Fukuda & Morichi 1999)
 - **Telephone-service** choice (Train et al. 1987)
 - **Occupation (job)** choice (Schmidt & Strauss 1975)
 - **Rail route** choice in Tokyo (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** (Fukuda et al. 2013)
 - **Facial expressions** (Robin et al. 2011)
 - **Political party** to support (Carey et al. 1995)

BART and DCM



Professor D. McFadden
(2001 Nobel Prize Winner)

"Conditional logit analysis of qualitative choice behavior," in P. Zarembka (ed.), *Frontiers in Econometrics*, pp. 105–142, Academic Press: New York, 1974.

Transportation: One of the most advanced DCM applications

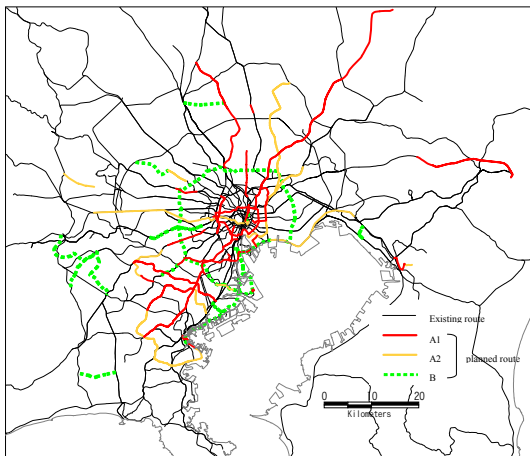


Figure: Planned rail routes in 2000 by 2015 with DCM-based demand forecasting (Morichi et al., 2001)

Transportation: One of the most advanced DCM applications

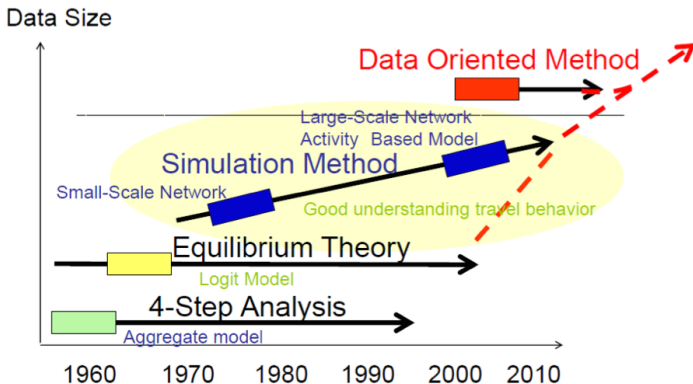
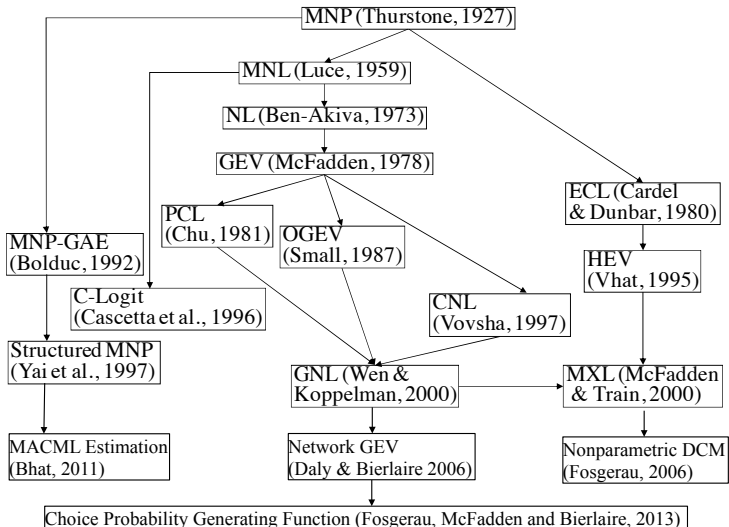


Figure: History of Travel Survey Methods (Hato, 2013)

History of Discrete Choice Models



Original Source by Hato (2001) and updated by Fukuda

- Ben-Akiva, M. & Lerman, S. (1985) Discrete Choice Analysis: Theory and Applications to Travel Demand, MIT Press.
[Now updated by Ben-Akiva and his colleagues. Downloadable at OCW-i]
- Train, K. (2003) Discrete Choice Methods with Simulation, Cambridge University Press. Downloadable at <http://eml.berkeley.edu/books/choice2.html>
[Also, the Japanese version (translated by Fukuda) will be downloadable at OCW-i.]
- 北村隆一・森川高行 [編] (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 materials will be provided at [OCW-i](#).

Class Schedule (Revised)

- ① (April 9) Choice Behavior and Binary Choice Models (BCM)
- ② (April 16) Estimation of BCM
- ③ (April 23) *Computer Lab. (1)*: Estimation of BCM
- ④ (May 7) Multinomial Choice Models: Logit and Probit
- ⑤ (May 14) Specification and Estimation of Multinomial Logit Models (MNL)
- ⑥ (May 21) *Computer Lab. (2)*: Estimation of MNL
- ⑦ (May 28) Statistical Tests of Discrete Choice Models
- ⑧ (June 4) Independent from Irrelevant Alternatives, Forecasting and Microsimulation
- ⑨ (June 11) *Computer Lab. (3)*: Statistical Testing & Forecasting
- ⑩ (June 18) Nested Logit Model (NL)
- ⑪ (June 25) Issues on Sampling
- ⑫ (July 2) *Computer Lab. (4)*: NL & Sampling Issues
- ⑬ (July 9) Mixed Logit Model (MXL) & Simulation-based Estimation
- ⑭ (July 16) Application of DCM in Transportation and *Computer Lab. (5)*: Estimation of MXL
- ⑮ (July 23) Optional

Course Evaluation and Advance Preparation

- 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.
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- 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.