Mathematical Modeling of Individual Choice Behavior （選択行動の数理モデル）[CVE.D401]

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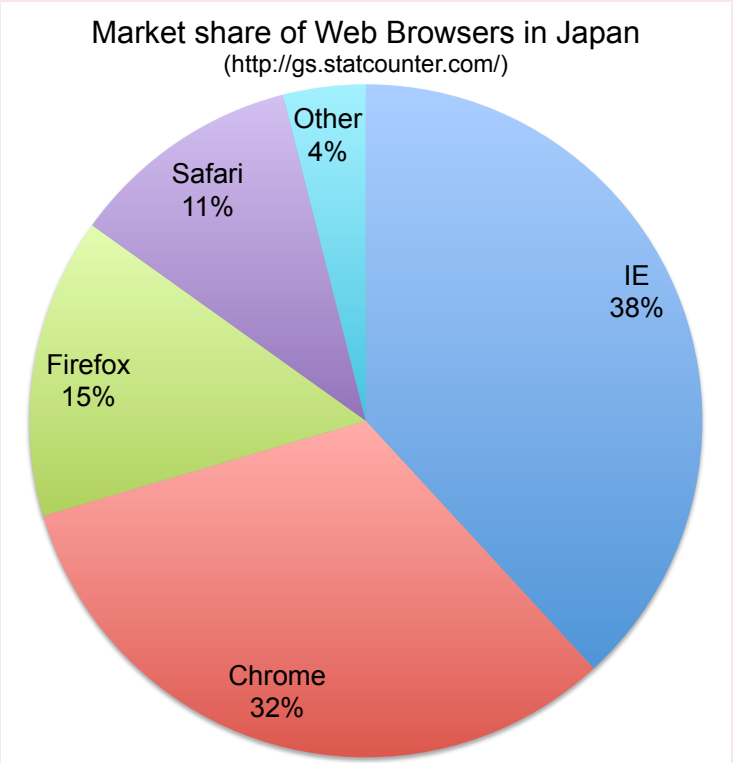
Motivation of this Course

Individuals Choices (Decision-making)

Aggregate Output (Market Demand/Share)



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".

Applications of DCM

- 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 Novel 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

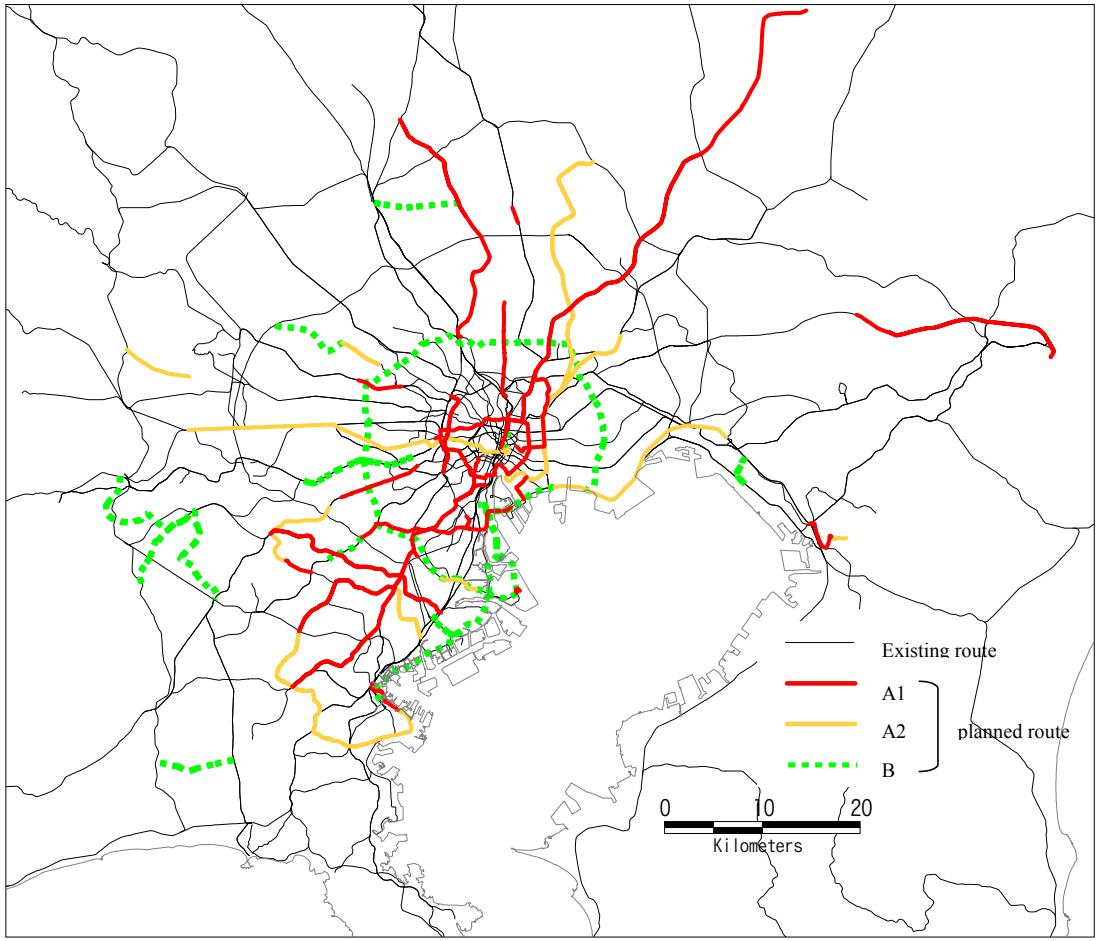


Figure: Planned rail routes in 2000 by 2015 with DCM-based demand forecasting (Morichi et al., 2001)

Transportation: One of the most advanced DCM applications

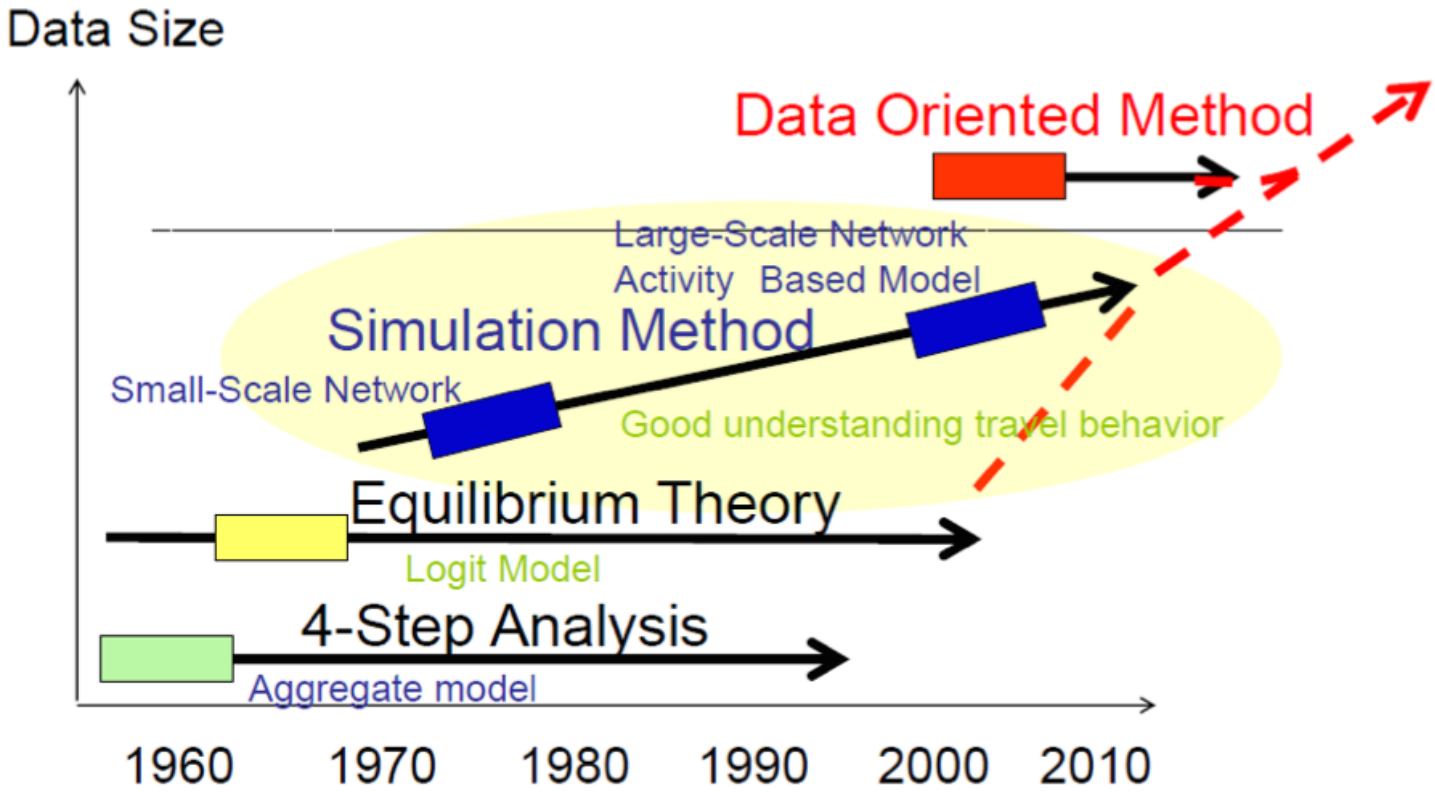
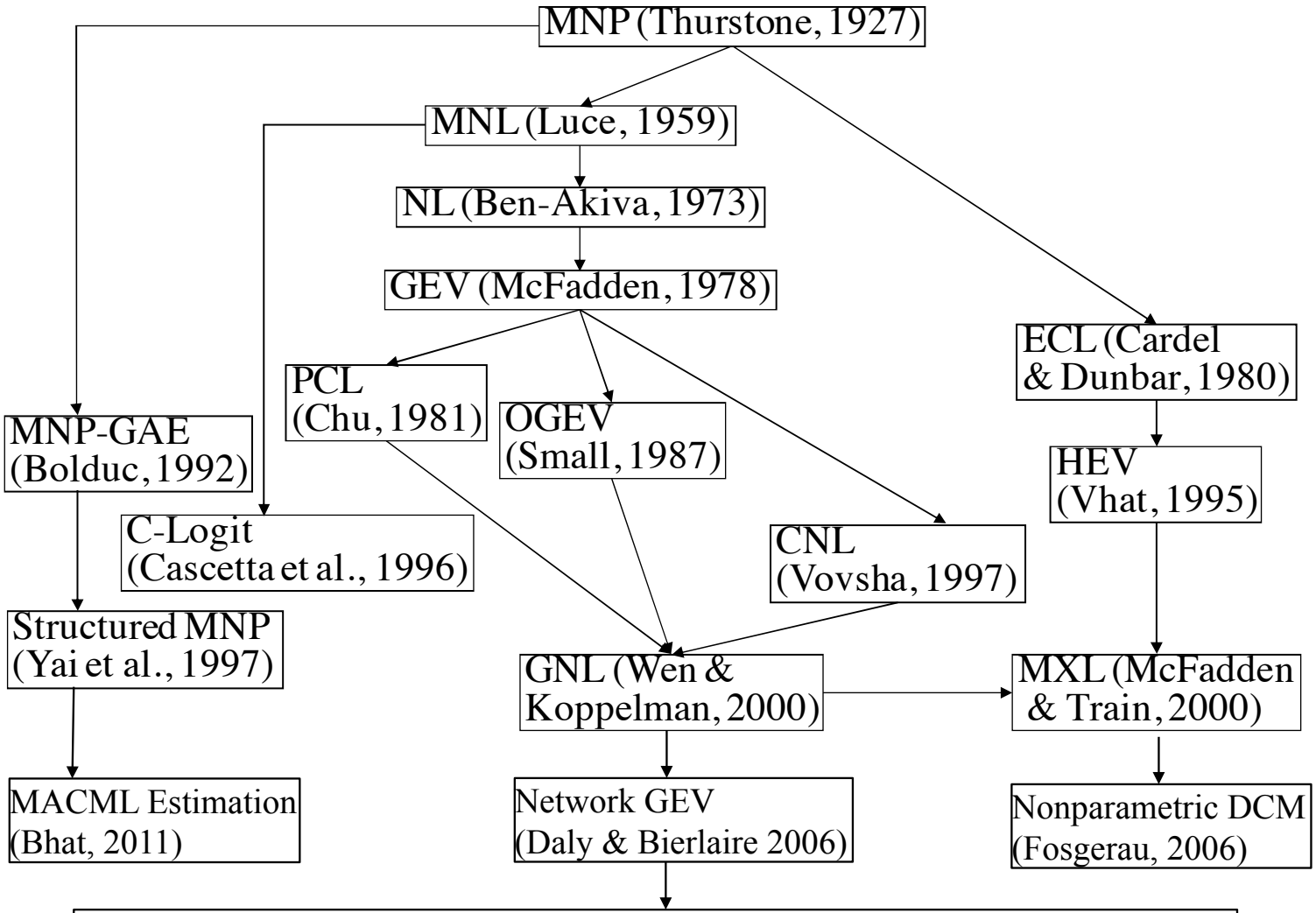


Figure: History of Travel Survey Methods (Hato, 2013)

History of Discrete Choice Models



Original Source by Hato (2001) and updated by Fukuda

Textbooks

BL Ben-Akiva, M. & Lerman, S. (1985) Discrete Choice Analysis: Theory and Applications to Travel Demand, MIT Press.

[[BBBW] Now upgraded by Ben-Akiva and his colleagues. Downloadable at OCW-i]

Tr 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.]

KM **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**.

JSCE **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

1. (April 7) Choice Behavior and Binary Choice Models (BCM)
2. (April 11) Estimation of BCM
3. (April 14) *Computer Lab. (1)*: Estimation of BCM
4. (April 18) Multinomial Choice Models: Logit and Probit
5. (April 21) Specification and Estimation of Multinomial Logit Models (MNL)
6. (April 25) *Computer Lab. (2)*: Estimation of MNL
7. (April 28) Statistical Tests of Discrete Choice Models
8. (May 2) Independent from Irrelevant Alternatives, Forecasting and Microsimulation
9. (May 9) *Computer Lab. (3)*: Statistical Testing & Forecasting
10. (May 12) Nested Logit Model (NL)
11. (May 16) Issues on Sampling
12. (May 19) *Computer Lab. (4)*: NL & Sampling Issues
13. (May 23) Mixed Logit Model (MXL) & Simulation-based Estimation
14. (May 26) *Computer Lab. (5)*: Estimation of MXL
15. (June 6) Recent Developments of DCM in Transportation

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.

- 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.