Georgia Institute of Technology
School of Civil and Environmental Engineering

CEE 6650
Discrete Choice Modeling

SYLLABUS

Instructor:

Patricia L. Mokhtarian
322 SEB
phone: 404-385-1443
e-mail: patmokh@gatech.edu

Course Objectives:

- To understand the behavioral, statistical, and econometric foundations for the formulation and estimation of discrete choice models.
- To explore a variety of discrete choice models and their application to travel demand forecasting and related subjects.
- To gain experience in the formulation, interpretation, and evaluation of discrete choice models using empirical data.

Learning Outcomes:

- knowledge of the basic theory of discrete choice models;
- ability to specify, estimate, and interpret basic discrete choice models.

Formal prerequisite: Calculus-level introduction to probability & statistics. **Informal prerequisites:** Linear algebra and regression analysis. Having had a course in regional travel demand forecasting is also helpful but not essential.

Text:

Ben-Akiva, Moshe and Steven R. Lerman (1985) *Discrete Choice Analysis: Theory and Application to Travel Demand.* Cambridge, Mass.: MIT Press.

Plus supplemental readings as assigned/recommended.

Assignments:

Grading will be based on three major assignments, each counting one-third of the grade. They will involve estimating discrete choice models using real data, with the aid of a software package such as Limdep/NLOGIT, R, Stata, Biogeme, or others. Additional problems will also be included with these assignments.

Teaming with ***one*** other person is allowed on the HW, at your choice. That is, you may team or not team, you choose your teammate (if any), and you are free to change the arrangement from one assignment to the next. Teamed assignments will receive a single grade for the team, and will be graded to the same standards as un-teamed assignments. Each member of the team is expected to engage thoroughly in, and to make substantive contributions to, ***all*** aspects of the assignment.

My general policy is not to allow three-person teams, because that dilutes the workload, and hence the understanding of the material and therefore the pedagogical value of the assignment, too much. This sometimes has the unfortunate result that someone who wants to team is the "odd person out", when everyone else is either already paired off or does not wish to team. In such cases, someone must end up unhappy, and for both pedagogical and social-psychological reasons I would rather force someone ***not*** to be on a team who wants to be on one, than to force someone to be ***on*** a team who doesn't want to be. In my philosophy, teaming is a "bonus", not an automatic right. So… if you want to team, start forming the team early.

Honor Code:

- Plagiarism is defined by Webster's Dictionary (http://www.merriam-webster.com/dictionary/plagiarism) as "the act of using another person's words or ideas without giving credit to that person." If caught plagiarizing, you will be dealt with according to the GT Academic Honor Code.
- You may discuss the assignment with other students in the class. However, all students or teams must submit their own homework solutions, written in their own words. In other words, the content of any assignment turned in should be *only* that of the person (people) whose name(s) is (are) on the assignment. Copying or borrowing from another person's or team's solution is a violation of the GT Academic Honor Code, and will be dealt with accordingly. Similarly, copying or borrowing from the lecture notes – or from any other source! – without proper attribution is a violation.
- Unauthorized use of any previous course materials ***such as graded homework assignments***, other than that explicitly allowed by me or my delegate, is prohibited in this course. Therefore, unauthorized use of such materials is a violation of the GT Academic Honor Code, and will be dealt with accordingly.
- When in doubt, don't assume or rationalize – ask! For any questions involving these or any other Academic Honor Code issues, please consult me or www.honor.gatech.edu.

Office of Disability Services:

The Georgia Institute of Technology has policies regarding disability accommodation, which are administered through the Office of Disability Services (http://disabilityservices.gatech.edu/). For students with disabilities, please contact this Office to request classroom accommodations.

Special Considerations Due to the COVID-19 Pandemic:

- As you may know, we are not allowed to require masks to be worn in the classroom. However, I will certainly be doing so, and I really really want you to do so as well. Sure, it's annoying and "not a good look for me" – I don't know anyone who enjoys it. But it's also an effective weapon in our arsenal for reducing transmission of a deadly disease. Grownups have learned that life is not all about "me", and that we all need to do some unenjoyable things from time to time, for the sake of vulnerable people in our midst (which, nowadays, is all of us, though some more than others). Yes, some people are *unable* to wear a face covering, for documented health reasons. But grownups will also not pretend to be such a person when it is not true. So please, be a grownup.

- With the same regard for your fellow human beings, ***please do not come to class if you have a temperature, cough, or are sneezing, or otherwise do not feel well!*** Similarly, I may need to do the same on any given day! If that is the case, then if at all possible I will either deliver the lecture remotely in real time, or point you to pre-recordings of it.

COURSE OUTLINE

Introduction (1-2 lectures)

Why probabilistic models
Applications of disaggregate discrete choice models

Review of probability and statistics fundamentals (3 lectures) (B-A & L Ch. 2; Kmenta Ch. 6; Theil Ch. 8)

Joint, marginal, and conditional distributions for discrete and continuous random variables (RVs)
Maximum likelihood estimation
Desirable properties of estimators

Theories of individual choice behavior (2-3 lectures) (B-A & L Ch. 3, lightly on 3.4-6; Stopher and Meyburg Ch. 16)

Noncompensatory models
Constant and strict utility theory; IIA
Random utility theory

Binary choice models (7 lectures) (B-A & L Ch. 4, lightly on 4.4, 4.6; Domencich and McFadden Chs. 4 & 5)

- Derivation of linear, logit, and probit models
- Comparison of binary logit model to logistic regression
- Prototypical model specification
- Maximum likelihood estimation
- Diagnostic tests (§§2.6 and 4.5, 7.1 - 7.4)
  - Quasi-t, χ^2, LRI (ρ^2 or pseudo-R^2), adjusted ρ^2, % correctly classified, success table

Multinomial choice models (8-9 lectures) (B-A & L Ch. 5; Train Ch. 2)

- Background
- Properties of the extreme value distribution
- Derivation of general and multinomial logit choice probabilities
- MNL: Testing for IIA
- MNL: Elasticities (disaggregate versus aggregate)
- Maximum likelihood estimation of multinomial logit
- Taste variations
  - Market segmentation
    - Bases for segmentation
    - Testing for significant differences between segments
- Multinomial probit

Other discrete choice models (4 lectures)

- Nested logit, generalized extreme value
- Dogit
- Ordinal response
- Mixed logit

Application issues (3 lectures)

- Aggregation (B-A & L Ch. 6)
- [Heterogeneity of choice sets]
- Sampling (B-A & L Ch. 8)
  - Choice-based sampling
- [Sampling of alternatives (B-A & L Ch. 9)]
- Ethical issues in modeling and forecasting