University of California, Davis
Institute of Transportation Studies

TTP 289A-003
CRN # 51562
Discrete Choice Modeling
Fall 2021
(Tu/Th, 2:10-4:00pm, 1120 Hart Hall)

SYLLABUS

Instructor:

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Office Hours:

By appointment

Course Details

Number of Units: 4
Grading: Letter graded

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

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.

Text:

- Ben-Akiva, Moshe and Steven R. Lerman (1985) Discrete Choice Analysis: Theory and Application to Travel Demand. Cambridge, Mass.: MIT Press.
- Train, Kenneth E. (2009) Discrete choice methods with simulation. Cambridge University Press.
- Ortuzar, Juan de Dios and Luis G. Willumsen (2011) Modeling Transport. Chichester: Wiley.
- Class handouts and supplemental readings as assigned.

Grading and Assignments:

Grading will be based on the following:

Attendance and participation in the class	5%
Pop-up quizzes	15%
Assignment 1	25%
Assignment 2	25%
Assignment 3-A (group)	15%
Assignment 3-B (individual)	15%

A total of four pop-up quizzes will be administered throughout the quarter. You can choose the best three out of four quizzes (each quiz will count for 5% towards the final grade).

There will be three major assignments. Each of the first two assignments will count 25% of the grade. At the end of the course, the final assignment (counting 30% of the grade, in total) will consist of two parts: one that can be developed as a group and one that needs to be developed individually. All assignments will involve using computer programming (R, LIMDEP, STATA or equivalent) to estimate discrete choice models using real data. Other problems will also be included with these assignments.

Teaming with one other person is allowed on the HW, at your choice, with the only exception of the second part of Assignment 3. You may team or not team for HW1, HW2 and HW3-A, choose your teammate (if any), and you are free to change the team 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.

Teams of three members are usually not allowed (unless under very special circumstances) due to the risk of diluting the workload too much. This prevents risks of reduced understanding of the material and pedagogical value of the assignments, as well as students' eventual disappointment about the unequal contributions by the team members.

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 UC Davis Code of Academic Conduct (http://sja.ucdavis.edu/files/cac.pdf).
- You may discuss the assignment with other students in the class. However, each student or team must submit her/his/their own homework solutions, written in her/ his/their own 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 solution is a violation of the UC Davis Code of Academic Conduct, 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 UC Davis Academic Honor Code, and will be dealt with accordingly.
- When in doubt, don't assume or rationalize -- ask! The instructor is here to answer your questions.
- For any questions involving these or any other Code of Academic Conduct issues, please consult me or visit http://sja.ucdavis.edu/

UC Davis Student Disability Center:

The University of California, Davis is committed to ensuring equal educational opportunities for students with disabilities. UC Davis has policies regarding disability accommodation, which are administered through the Student Disability Center (https://sdc.ucdavis.edu/). Students are responsible for contacting each of their instructors in advance to ensure appropriate arrangements are made for requested accommodations. Please visit the Center website for more information.

Course Outline:

The following content will be covered in the course. Eventual changes in the course outline and lecture schedule might be introduced depending on the student preparation (see, in particular, the informal prerequisites of the class), and any additional needs that might arise.

- Introduction:
    - Why probabilistic models
    - RP and SP data
    - Applications of disaggregate discrete choice models
- Review of prob. and statistics fundamentals
    - Joint, marginal, and conditional distributions for discrete and continuous RVs

  - Maximum likelihood estimation
  - Desirable properties of estimators
- Review of linear regression models
  - Ordinary least squares estimation
  - Interpretation of model results
- Theories of individual choice behavior
  - Noncompensatory models
  - Constant and strict utility theory; IIA
  - Random utility theory
- Binary choice models
  - Derivation of linear, logit, and probit models
  - Comparison of binary logit model to logistic regression
  - Prototypical model specification
  - Maximum likelihood estimation
  - Diagnostic tests (Quasi-t, $\chi 2$, $\rho 2$ or pseudo-R2, adjusted $\rho 2$, % correctly classified, success table)
- Multinomial choice models
  - 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
  - Nested logit
  - Generalized extreme value
  - Introduction to ordinal response models, latent-class models and mixed logit
- Application issues
  - Causality and interpretation of results
  - Sampling
  - Choice-based sampling
  - Applications to new transportation modes and emerging mobility services (shared mobility, e-scooters, AVs, etc.)
- Ethical issues in modeling and forecasting

Acknowledgements:

A sizable portion of the content of the class handouts posted on the course website was created by Prof. Patricia Mokhtarian for her course(s) in Discrete Choice Modeling, with additional contributions from several graduate students and other colleagues during previous years.