Discrete Choice Modeling

TTP 289A-002 (CRN 45508) - Winter 2021

M/W 4:10-6 pm - *REMOTE*

Contact Information

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Office Hours are (currently) by appointment

Course Details

- Number of units: 4
- Grading: Letter grade.
- **Notes for Winter 2021**.
    - Due to the continuing COVID-19 pandemic, the course will be taught remotely.
    - The current plan is to offer the course Tu/Th 4:10-6 pm using Zoom.
    - I may attempt to create some videos to partially "hybridize" the course so that a full 4 hours per week on Zoom is not required.
    - Past experience suggests that it is very difficult to anticipate what types of scheduling conflicts multidisciplinary students like ours might have. So, there is at least some potential flexibility for moving the specific meeting times. However, I would need to get lots of feedback from the vast majority of potential students well in advance for this to occur.

Course Description

- Many aspects of policy, management, and engineering require an understanding of how humans make decisions, and why. Many times these decisions involve **discrete choices**, e.g., which product to purchase, which travel mode (drive alone, carpool, bus, train) to use for a particular trip, whether to participate in the workforce, etc.
- **Discrete choice modeling** has become an essential skill for researchers who need to understand and model consumer behavior and market demand for products and services in a wide variety of fields, including travel demand forecasting, economics, marketing, and energy policy.
- The course provides an introduction to both theory and practical aspects of modeling of individual choice behavior, including data requirements, model formulation, statistical estimation and testing, interpretation, and prediction/forecasting for applications in policy evaluation, service and product design, etc.
- Students will gain hands-on experience, performing exercises using software and data sets. Hands-on work will include both homework assignments and a course project.
- **Prerequisites:** Students should have at least some previous background in standard statistical analysis at the level of linear regression. (Students with concerns about prerequisites should contact and discuss this with the instructor.)

Course Objectives

- Students will gain an understanding of the behavioral and statistical foundations of discrete choice models required for formulating and estimating their own models in their respective fields.
- Students will learn about the various families and types of discrete choice models, and when they would be applied in varying applications.
- Students will gain experience in formulating, estimating, testing and interpreting discrete choice models using empirical data sets. The course will use the Apollo choice modeling R package.

Texts

- There is no official text for the course. Students will be provided with a variety of handouts and pdfs of readings during the course. However, students will find the following references to be useful:
    - Ben-Akiva, Moshe and Steven R. Lerman (1985) *Discrete Choice Analysis: Theory and Application to Travel Deman*d. 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*.

Grading Assignments

- Grading will be based on the following on a mixture of individual and group modeling assignments, and quizzes:

Class participation	10%
Quizzes	15%
Assignment 1	15%
Assignment 2	20%
Assignment 3a (group)	20%
Assignment 3b (individual)	20%

- **DSB Note:** Some of the details on grading and assignments are subject some minor modification because this is the first time I am teaching this course. I will provide updates as soon as it is practical. The following provides an initial baseline.
- A total of four 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 (individual) assignments will count 20% of the grade. They will involve performing modeling and analysis using datasets provided by the instructor. The third assignment is divided into two parts. In part a, students will work in pairs to develop a research topic that requires problem formulation, identification of data set(s), and a modeling strategy. Students will receive feedback and advice. In part b, students are responsible for executing the strategy and producing a report on an individual basis. There is the possibility that we may have students present their results.

- Students may confer and provide support to one another on Assignments 1 and 2. However, students must produce the final product on their own as described below under the honor code review.
- Groups are limited to pairs, and groups of three members are generally not allowed (unless under very special circumstances, considered on a case-by-case basis). 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

- UC Davis is committed to educational equity in the academic setting, and in serving a diverse student body. All students who are interested in learning about how disabilities are accommodated can visit the Student Disability Center (SDC). If you are a student who requires academic accommodations, please contact the SDC directly at sdc@ucdavis.edu or 530-752-3184. If you receive an SDC Letter of Accommodation, submit it to your instructor for each course as soon as possible, at least within the first two weeks of a course.

Other Rights and Responsibilities

- All participants in the course, instructor and students, are expected to follow the UC Davis Principles of Community, which includes affirmation of the right of freedom of expression, and rejection of discrimination. The right to express points-of-view without fear of retaliation or censorship is a cornerstone of academic freedom. A diversity of opinions with respectful disagreement and informed debate enriches

learning. However, in this course, any expression or disagreement should adhere to the obligations we have toward each other to build and maintain a climate of mutual respect and caring.

- All material in the course that is not otherwise subject to copyright is the copyright of the course instructor and should be considered the instructor's intellectual property.

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. A more detailed schedule grid will be provided as we get closer to the start of the quarter.

- Introduction:
    - o Why probabilistic models
    - o RP and SPdata
    - o Applications of disaggregate discrete choice models
- Review of prob. and statistics fundamentals
    - o Joint, marginal, and conditional distributions for discrete and continuous RVs
    - o Joint, marginal, and conditional distributions for discrete and continuous RVs Maximum likelihood estimation
    - o Desirable properties of estimators
- Review of linear regression models
    - o Ordinary least squares estimation
    - o Interpretation of model results
- Theories of individual choice behavior
    - o Noncompensatory models
    - o Constant and strict utility theory; IIA
    - o Randomutilitytheory
- Binary choice models
    - o Derivation of linear, logit, and probit models
    - o Comparison of binary logit model to logistic regression
    - o Prototypical model specification

- o Maximum likelihood estimation
- o Diagnostic tests (Quasi-t, χ2, ρ2 or pseudo-R2, adjusted ρ2, % correctly classified, success table)

• Multinomial choice models o Background

- o Properties of the extreme value distribution
- o Derivation of general and multinomial logit choice probabilities
- o MNL: Testing for IIA
- o MNL: Elasticities (disaggregate versus aggregate)
- o Maximum likelihood estimation of multinomial logit
- o Tastevariations(marketsegmentation,basesforsegmentation,testingfor significant differences between segments)
- o Multinomial probit

• Other discrete choice models

- o Nested logit
- o Generalized extreme value
- o Introduction to ordinal response models, latent-class models and mixed logit

• Application issues

- o Causality and interpretation of results
- o Sampling
- o Choice-based sampling
- o Applications to new transportation modes and emerging mobility services (shared mobility, e-scooters, AVs, etc.)