University of California, Davis

Institute of Transportation Studies

**TTP 289A-004 (CRN 80451)**

**Discrete Choice Modeling**

*Spring 2018*

(Tu/Th, 2:10-4:00pm, 5 Wellman)

**SYLLABUS**

# Instructor:

Giovanni Circella

Institute of Transportation Studies

1715 Tilia Street, #1105

phone: 530-752-1072

e-mail: [gcircella@ucdavis.edu](mailto:gcircella@ucdavis.edu)

# 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.
* Supplemental readings as assigned.

# Assignments:

Grading will be based on three major assignments, each counting one-third of the grade. They will involve using computer programming (R, LIMDEP 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. You may team or not team, 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
  + 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, χ2, ρ2 or pseudo-R2, adjusted ρ2, % 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
  + Ordinal response
  + Mixed logit
* Application issues
  + Causality and interpretation of results
  + Aggregation
  + Sampling
  + Choice-based sampling
* Ethical issues in modeling and forecasting

# Draft Lecture Schedule:

|  |  |  |  |
| --- | --- | --- | --- |
| **Week** | **Lecture #** | **Date** | **Topic** |
| Week 1 | 1 | Tuesday, April 3 | Introduction |
|  | 2 | Thursday, April 5 | Review – probability and statistics |
| Week 2 | 3 | Tuesday, April 10 | Review – prob. and statistics/linear regression models |
|  | 4 | Thursday, April 12 | Review – linear regression models |
| Week 3 | 5 | Tuesday, April 17 | Theories of individual choice behavior |
|  | 6 | Thursday, April 19 | Theories of individual choice behavior (2) |
| Week 4 | 7 | Tuesday, April 24 | Binary choice models |
|  | 8 | Thursday, April 26 | Binary choice models (2) |
| Week 5 | 9 | Tuesday, May 1 | Binary choice models (3) |
|  | 10 | Thursday, May 3 | Binary choice models (4) |
| Week 6 | 11 | Tuesday, May 8 | Multinomial choice models |
|  | 12 | Thursday, May 10 | Multinomial choice models (2) |
| Week 7 | 13 | Tuesday, May 15 | Multinomial choice models (3) |
|  | 14 | Thursday, May 17 | Multinomial choice models (4) |
| Week 8 | 15 | Tuesday, May 22 | Other discrete choice models |
|  | 16 | Thursday, May 24 | Other discrete choice models (2) |
| Week 9 | 17 | Tuesday, May 29 | Other discrete choice models (3) |
|  | 18 | Thursday, May 31 | Causality and interpretation of results |
| Week 10 | 19 | Tuesday, June 5 | Application issues |
|  | 20 | Thursday, June 7 | Application issues / Ethical issues |