TTP 289A-006 Winter 2020 (CRN 75026)
Advanced Choice Modeling

(Draft) Course Syllabus: Winter 2020
Version: November 21, 2019 (Subject to additional updates-See remarks at the end!)

Course Information

- **Instructor**
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- **Format/Session Information**
  - Format: 4 units (3 units of lecture plus 3 units of lab, per week).
  - Time/Day: Wednesday 9 am-11:50 am (lecture)
  - Location: 2102 Gallagher Hall
  - Grading: Letter graded

- **Prerequisites:** This is an advanced course in discrete choice modeling, which presumes prior training and experience in formulating, estimating, and performing inference for discrete choice models (e.g., *logistic regression* and/or *multinomial logit*) at an introductory level. This would also presume basic knowledge and experience in statistics and/or econometrics more generally (e.g., linear regression, statistical estimation and hypothesis testing, with some background in relevant mathematics such as matrix algebra and basic calculus). An "operational" prerequisite would be TTP 289A-003 (Fall 2019) on Discrete Choice Modeling (Prof. Circella). However, other graduate students with equivalent or similar background may also take the course with consultation and permission of the instructor. In particular, students from economics and agricultural and resource economics with relevant training would be most welcome.

Course Overview and Objectives

The primary objective of this course is to give students an opportunity to learn about and gain hands-on experience with *advanced* models and methods in *discrete choice modeling* for the purpose of supporting a range of research and empirical analysis objectives that require these approaches. The range of issues covered will include: theoretical underpinnings, data requirements and collection, alternative modeling families and formulations, statistical estimation and inference, and use of models to produce analyses and conclusions.

The usual purpose of these models/methods is to gain a deeper understanding of consumer choice behavior and preferences, and in many cases to produce projections of their behavior under counterfactual scenarios in a wide range of application areas including: transportation and travel demand (e.g., travel modes, vehicles), energy (choice of energy appliances), marketing (a wide variety of product categories), and other

personal/household choices with great economic and social importance (labor force participation, educational choices, housing, etc.).

A variety of choice modeling families have been developed in the literature that are more complex than standard multinomial choice. In many cases, these exist to address major limitations of the standard conditional logit model (e.g., independence from irrelevant alternatives) due to such factors as taste variation (unobserved heterogeneity in preferences) and the effect of unobserved attributes that lead to problems with, e.g., endogeneity. Example model forms include: mixed multinomial logit, multinomial probit, nested multinomial logit, panel and error component logit, latent class, and hybrid choice models, as well as their required estimation procedures. Beyond this "summary list," we emphasize that, early on in the course, we will also address the role of microeconomic theory-based frameworks that support and unify this material, as well as additional topics such as multiple-discrete-continuous models (e.g., MDCEV).

In many cases, choice models are used to provide insights into how consumers might respond to introduction of new types of offerings that *do not currently exist*. In these cases, stated preference data might be collected via discrete choice experiments to address the situation. This course will cover discrete choice experiments: The degree of depth and attention can be adjusted as a function of student needs/preferences.

Course Approaches

An important aspect of the course approach is that, in addition to covering advanced topics in a lecture format, a substantial portion of the course be spent in *hands-on activities*. By "hands on," we mean data-based project assignments, and a major course project. For this reason, the course format is to allocate 3 of the 4 units to lecture and presentation of examples, with one unit of lab (linked to the hands-on activities). As noted in the course information, lecture will be on Wednesday mornings in Gallagher Hall (9 am – 12 noon, with one break).

With regard to software: Our primary default approach will be to introduce and use the new Apollo software package (produced by Stephane Hess and co-workers). Students are not necessarily limited to Apollo, and we can discuss how other alternatives (e.g., LIMDEP, Stata, or various R packages) might be used on a case-by-case basis.

As has been noted earlier, we would like to maintain the flexibility to fine-tune the course and adjust the amount of time devoted to various topics. Accordingly, the remainder of the syllabus will be presented as a sequence of topics with approximate time allocation that are subject to revision depending on what happens in the course.

Background/Reference/Text Material

For references purposes, we will draw on a variety of sources (many of which you may already be familiar with). However, for the first reference below please note: I have obtained permission from Profs. Joan Walker and Moshe Ben-Akiva to use an

unpublished draft manuscript (dated 2014) that represents an update to Ben-Akiva and Lerman (1985). ***We can use this, but it cannot be circulated beyond the class membership***.

- Ben-Akiva M, Bierlaire M, McFadden D, Walker J (2014 draft) *Discrete Choice Analysis*.
- Ben-Akiva M, Lerman S (1985) *Discrete Choice Analysis*. MIT Press.
- Train K (2009) *Discrete Choice Methods with Simulation, Second Edition*. Cambridge University Press.
- Train K (1986) *Qualitative Choice Analysis*. MIT Press.
- Hess S, Palma D (2019). "Apollo: a flexible, powerful and customisable freeware package for choice model estimation and application." *Journal of Choice Modelling*, **32**. doi: 10.1016/j.jocm.2019.100170.
- Hess, S and D Palma (2019) *Apollo: a flexible, powerful and customisable freeware package for choice model estimation and application*. Version 0.1.0*, User manual, www.ApolloChoiceModelling.com, Choice Modelling Centre University of Leeds, November 17, 2019*. [*Note that this manual is subject to frequent updating.]

Additional readings (e.g., journal articles, etc.) will be added as needed.

List of Topics/Ordering

The following is an initial list of topics, placed in an order to generally coincide with a ten-week quarter. As noted above, the final schedule as executed will have some flexibility that will take account of such factors as student interests/preferences (as well as the realities of this being a first-time course offering). Between now and the first day of class, I will add more details below each item.

Topic 1a: Brief review of introductory theory for discrete choice models.

Topic 1b: Introduction to estimation of (simple logit) choice models using Apollo (I).

Topic 2a: Introduction to estimation of choice models using Apollo (II).

Topic 2b: Introduction to mixed (multinomial) logit models (theory and formulation).

Topic 3: Specification and estimation of mixed logit models in Apollo.

Topic 4: Introduction to theory and design of discrete choice experiments.

Topic 5: Formulation and estimation of Stated Preference and joint Stated/Revealed Preference (SP/RP) models.

Topic 6: Latent class models.

Topic 7: Hybrid choice models.

Topic 8a: Review of microeconomic theory for discrete/continuous consumer choice.

Topic 8b: Introduction to Multiple Discrete-Continuous Extreme Value (MDCEV) model.

Topic 9: Nested multinomial logit models.

Topic 10: Alternative choice modeling estimation methods (e.g. Bayesian).

Course Requirements and Grading

The topic/schedule above outlines what would occur during normally scheduled class sessions when we are all together as a group. The lab portion of the course is associated with a number of problem set/assignments that require hands-on application of the material covered in class. Grading will be based on the following:

Class Participation (10%)
Problem Sets (40%)
Short quizzes (20%)
Group project (30%)

Problem sets: Because this is a first-time offering, I have not yet worked out all of the details. The main idea is that, after covering a topic in class, there will be a follow-up assignment to be done outside of class to that relies on the material, and requires hands-on work to implement what was learned (which relates to the 1-unit lab concept). This almost always involve: a data set, a problem statement, specifying and estimating a model in Apollo, and formulating conclusions. (I am still in the process of identifying a variety of data sets). I currently anticipate anywhere from 3-5 problem sets (which will be a function of how much work will be required per problem set). It may be that I also implement a plan where there are X problem sets, and students can choose to turn in X-Y of them. Problem sets will generally be done on an individual basis, but we will establish ground rules that allow for an appropriate level of interaction among students that falls well short of, e.g., one student doing the work and two students turning in results.

Group Project: This is the part of the course where students themselves can identify a specific project that they themselves are interested in. A group in this case is two people working together. This is the aspect of the course where students might identify a project that is directly relevant to their own research (although we realize that this might not be directly relevant for all students).

Code of Academic Conduct
An absolute requirement in this course (and in our program) is that all students must rigorously adhere to the ethical standards specified in the Code of Academic Conduct. The full text of this code is available at this link: http://sja.ucdavis.edu/files/cac.pdf.

In this course, the most critical thing will be to set boundaries for appropriate levels of collaboration in the problem sets.

Final remarks on November 21, 2019 version of the syllabus

As noted above, because this is a first time offering (and because I want to incorporate feedback and preferences of students) I will be continually updating and adding more detail to this syllabus between now and the start of the quarter.

Thus far it appears to have been too early for students to provide this type of feedback.

NOTE: To members of Giovanni's Fall Quarter Discrete Choice Course. You all are the easiest for me to reach for the next few weeks, so it will be possible for me to notify you of updates (and to keep asking for feedback!)

But, for students *not* taking this course: It will be critical for you to either (1) go ahead and sign up for this course so that I can reach you via Canvas, or (2) send me your email address and other information about you so that I can keep you in the loop.