The University of Texas at Austin Dr. Chandra Bhat
Department of Civil, Architectural & Environmental Engineering Spring 2012

CE 392R: Discrete Choice Theory and Modeling (3 credits)

Description

Econometric discrete choice analysis is an essential component of studying individual choice behavior and is used in many diverse fields to model consumer demand for commodities and services. Typical examples of the use of econometric discrete choice analysis include studying labor force participation, professional occupation, residential location, and house tenure status (owning versus renting) in the economic, geography, and regional science fields; choice of travel mode, destination and car ownership level in the travel demand field; purchase incidence and brand choice in the marketing field; and choice of marital status and number of children in sociology.

This course will provide the student with an understanding of the theory and models of individual choice behavior. The course builds on econometric modeling approaches to develop guidelines for the formulation and estimation of models of choice behavior and their use in service and product design, marketing and prediction. Practical problems (using the econometric software "BIOGEME" for estimation) will be assigned to give students familiarity with models discussed in class. These problems will focus on choice behavior in the context of travel demand analysis. However, the class instruction/discussion will be general and will focus on theory and modeling methodology for application to any discrete choice context.

Students are required to undertake a course project in choice model development and application. Students are free and will be encouraged to undertake a project that is closely related to their field of specialization.

Course Content

Methods and statistics of model estimation with emphasis on maximum-likelihood estimation; Individual choice theory; binary choice models; unordered multinomial and multi-dimensional choice models; sampling theory and sample design; ordered multinomial models, aggregate prediction with choice models; introduction to advanced concepts such as accommodating unobserved population heterogeneity in choice behavior, joint stated preference and revealed preference modeling, and longitudinal choice analysis; review of state-of-the-art and future directions.

Pre-requisites

Familiarity with matrix algebra, statistical estimation and hypothesis testing, linear regression analysis, and basic differential calculus.

Format

Classes will be conducted in lecture/discussion format. Students are expected to contribute to class discussions. Homework assignments will be given; these will provide a basis for some of the class discussion. Each student will undertake a course project in model development and/or application.

Grading

Grades will be based on homework assignments (60%), class participation (10%), and Course Project (30%).

Project

A quantitative analysis project will be undertaken separately by each student (or pair of students, by permission). The project will consist of identifying a discrete choice analysis problem, defining the problem, and outlining an approach to the problem including issues of data acquisition, model formulation, estimation and interpretation of empirical results. The written part of the project should be clear, well-structured, and should achieve a quality consistent with that of a paper submitted for review in professional journals. The oral presentation should be clear and should succeed in sharing (with the rest of the class) the most important elements of the project in a brief period of time.

Project Abstract and Report Outline

A brief abstract of the project (indicating the topic of the research, data source to be used, and methodology to be applied) and a draft outline of the project report will be due on March 8th. The final project report is to be turned in by noon on May 8th. Student presentations are scheduled for April 19th, April 26th, April 27th, and May 3rd during the class period.

Web Site

The web site for the course is https://courses.utexas.edu (Blackboard). Once you get to this site, log in with your UT EID and password and select CE392R from the list of courses. The web site will include the main text, course contents, course calendar, data sets to be used in the assignments, additional datasets that may be used in projects, the BIOGEME software, and several miscellaneous notes/links.

Course Calendar

See "Calendar of Course Events" at the web site. Note that an additional class period will be held on January 20th, January 27th, January 30th, February 6th, February 13th, February 20th, March 2nd, March 19th, and April 27th. No classes will be held on January 24th, January 26th, February 7th, February 28th, March 22nd, April 12th, April 17th, April 24th, and May 1st (the April class periods will be open for discussions regarding student projects). The front-end "loading" of the course is being done for several reasons. First, much background material will need to be covered in the beginning and additional classes early on will get us over this background "hump" early in the semester. Second, it will ensure a more uniformly-spaced distribution of the assignments. Third, the early coverage of material will allow students to start working on their projects early. Finally, the intent is also to provide students with more time toward the end of the semester to work on their projects.

Meeting Time and Location: Tuesdays and Thursdays 3:30-5:00 pm, ECJ 7.202

Office Hours: Mondays and Tuesdays 2:00-3:30 pm, ECJ 6.810

Other General Information

Letter grades are used to record the instructor's evaluation of students' performance in a course. The following grades are used: *A*, *A*–, *B*+, *B*, *B*–, *C*+, *C*, *C*–, *D*+, *D*, *D*–, and *F*. To receive credit for a course, an undergraduate student must earn a grade of at least *D*–. To include a course in the Program of Work for a graduate degree, a graduate student must earn a grade of at least *C*.

School of Engineering Drop Policy:
From the 1st through the 4th class day, graduate students can drop a course via the web and receive a refund. During the 5th through 12th class day, graduate students must initiate drops in the department that offers the course and receive a refund. After the 12th class day, no refund is given. No class can be added after the 12th class day. From the 13th through the 20th class day, an automatic Q is assigned with approval from the Graduate Advisor and the Graduate Dean. From the 21st class day through the last class day, graduate students can drop a class with permission from the instructor, Graduate Advisor, and the Graduate Dean. Students with 20-hr/week GRA/TA appointment or a fellowship may not drop below 9 hours.

Students with Disabilities:
The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Division of Diversity and Community Engagement, Services for Students with Disabilities, 471-6259 (voice) or 232-2937 (video phone) or http://www.utexas.edu/diversity/ddce/ssd.

Web-Based Class Sites:
Web-based, password-protected class sites will be associated with all academic courses taught at the University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1. For information on restricting directory information, see the General Information Catalog or go to: http://registrar.utexas.edu/docs/catalogs/gi/ut-catalog-gi-11-12.pdf (Chapter 9 Educational Records).

Academic Integrity:
Students who violate University rules on academic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on academic dishonesty will be strictly enforced. For further information, visit the Student Judicial Services web site http://deanofstudents.utexas.edu/sjs/.

Anticipated Homework Assignments (with expected dates of distribution, submission and return)

1. **BIOGEME Familiarization and Binary Choice Models**
   Distribution date: February 6 Due date: February 16 Return date: February 20

2. **Multinomial Logit Estimation and Interpretation**
   Distribution date: February 20 Due date: March 2 Return date: March 6

3. **Multinomial Logit Specification Refinement**
   Distribution date: March 6 Due date: March 19 Return date: March 27

4. **Nested Logit Models - Specification and Estimation**
   Distribution date: March 27 Due date: April 5 Return date: April 10

5. **Ordered Response Model Estimation**
   Distribution date: April 10 Due date: April 19 Return date: April 27

Readings

Readings are assigned to supplement lecture material. The main text for the course is *A Self-Instructing Course (SIC) in Mode Choice Modeling: Multinomial and Nested Logit Models*, prepared for U.S. Department of Transportation, Federal Transit Administration, by Frank S. Koppelman and Chandra Bhat, 2006. Readings will also be assigned in *Discrete Choice Analysis: Theory and Application to Travel Demand* by Moshe Ben-Akiva and Steven R. Lerman. The main text (SIC) will be made available at the web site for the course. Readings from Ben-Akiva and Lerman (BL) will be distributed in class. Occasionally, readings will include journal papers which will be provided in class. A detailed listing of topics and readings is provided below.

Topic	*Reading*
1. Introduction and overview (1 class)	SIC, Chapter 1
2. Elements of the choice process (1 class)	SIC, Chapter 2
3. Utility-based choice theory (1 class)	SIC, Sections 3.1-3.3
4. Binary choice models: Deterministic and random terms (1 class)	SIC, Sections 3.4-3.5 BL, Sections 4-4.1
5. Binary choice models: Choice probabilities and invariance to utility scale and location (1 class)	BL, 4.2
6. Binary choice models: Maximum likelihood estimation (2 classes)	BL, 4.4

7.	Binary choice models: Fit measures (1 class)	BL, 4.5
8.	Binary choice models: Empirical specification and interpretation (1 class)	Example using SIC data at the web site
9.	Binary choice models: Marginal/elasticity effects and aggregation issues (1 class)	Notes at web site; SIC, Chapter 8
10.	Multinomial logit model (MNL): Overview and structure (1 class)	BL, 5.1-5.2
11.	MNL: Estimation and basic specification (1 class)	SIC, 4.1, 4.6
12.	MNL: Properties and elasticity/marginal effects (1 class)	SIC, 4.2-4.5
13.	MNL: Data requirements and structure (1 class)	SIC, 5.1-5.5
14.	MNL: Application and interpretation (1 class)	SIC, 5.6-5.8, 7.1-7.3
15.	MNL: Specification refinements (1.5 classes)	SIC, 6.1-6.2, 7.4
16.	MNL: Market segmentation and testing (1.5 classes)	SIC, 6.3-6.4
17.	Nested logit model (NL): motivation and formulation (1 class)	SIC, 8.1-8.2
18.	NL: Choice probabilities (1 class)	SIC, 8.2 (but not 8.2.2)
19.	NL: Implied competitive structure and estimation (1 class)	SIC, 8.2.2
20.	NL: Testing alternative structures and application (1 class)	SIC, 8.3-8.4, 9, 10
21.	Ordered-response models (OR): theory and structure (1 class)	MZ paper
22.	OR: Estimation and elasticity/marginal effects (1 class)	Notes at web site
23.	OR: Application and comparison with MNL (1 class)	Bhat and Pulugurta paper, example using data at website
24.	Introduction to advanced discrete choice models (1 class)	SIC, 12