

# USP 657: Discrete Choice Modeling

Portland State University, Fall 2022

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**Fall 2022**  
**Tue 10:00-12:30**

**3 credits**  
**Course website: Canvas**

## Overview:

Discrete choice models are widely used for the analysis of individual choice behavior and can be applied to choice problems in many fields such as economics, environmental management, engineering, urban planning, etc. Recent applications to predict changes in demand and market shares include areas such as choice of travel mode, coffee brand, telephone service, soft drinks and other foods, and choice of durables such as automobiles, air conditioners, and houses.

This course presents the theory and practice underlying the formulation and estimation of models of individual discrete choice behavior with applications to travel, travel related and other choices. The course will provide students with an understanding of the theory, methods, application and interpretation of multinomial logit (MNL), nested logit and other members of the Generalized Extreme Value (GEV) family of models. It also includes introductions to advanced topics such as mixed logit models, comparison with machine learning algorithms, logit models with latent variables, probit models etc depending on the progress on interest of the class.

## Course Objectives:

- Develop an understanding of the theory of choice modeling.
- Familiarization with and understanding of the art, science and methods of discrete choice modeling.
- Develop the ability to use theory, judgment and statistical analysis to obtain enhanced model specifications.
- Become familiar with relevant software and its use.
- Become familiar with current research in choice modeling.

## Requirements

Familiarity with intermediate calculus and intermediate statistics including hypothesis testing and linear regression will be helpful in understanding some of the concepts covered in this class.

We will use the R statistical software and RStudio; both is free and available for download at <http://cran.r-project.org> and <https://www.rstudio.com>. If you're not familiar with R (yet), you can use a Graphic User Interface (GUI) package such as jamovi (<https://www.jamovi.org/>) or RCommander (<https://socialsciences.mcmaster.ca/jfox/Misc/Rcmdr/>) as your main interface to R to ease the learning curve. R examples will be used during regular sessions, and instructions of working with R will be offered to assist in using R to complete the assignments. If you have been using another general purpose statistical software (SPSS, Stata, SAS, etc), they support common discrete choice models and you can continue using it. Another free open source software option is Biogeme (<http://biogeme.epfl.ch/home.html>).

Classes will be conducted in lecture/discussion format. Readings for each topic will be assigned and expected to be read before class. Digital copies of lecture notes, homework assignments, and links to supplemental reading materials will be made available via the course website.

Grades will be based on 3 homework assignments (60%) and a class project and presentation (30%+10%).

#### HOMEWORK ASSIGNMENT (3\*20%)

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Homework assignments provide an opportunity to experiment with and learn about model specification and testing. Unless otherwise specified, all homework will be submitted as a single electronic document with figures, tables and attachments included in the main document using the provided report guidelines and sample. Clarity in writing and presentation will be taken into account in grading. Students may collaborate on the approach to and analysis of homework assignments but are expected to prepare and present results and interpretations independently.

#### CLASS PROJECT (40%)

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In this class project, you will explore a topic of your choosing in depth, applying discrete choice modeling method for your data analysis. The paper must include original data analysis. This most likely will be analysis of secondary data, such as a travel survey (e.g. 2009 NHTS, OHAS), the American Housing Survey, etc. If you want to collect your own quantitative data or perform a qualitative analysis (e.g. in depth observation, interviews, content analysis, etc.), that's possible, but will take more planning and work. Check with me first.

Details:

- 15-20 pages, double-spaced, not including figures, tables, and references.
- Initial topic due in class on October 11. This should include a brief description of the topic, a list of key references (including academic literature), specific research question(s) and hypotheses, and the data source(s) you plan to use.
- Paper updates due in class on November 1. This should include a draft of the introduction/background sections, the literature review, and the methodology.
- Final paper due December 4 at 5 pm.

The best papers (high A grades) will be worthy of submission to an academic journal. Use empirical journal articles as a model to follow in terms of format, style, etc.

**Citations** You must cite all of your sources in your work. Please review this web site about citations: [http://library.pdx.edu/citing\\_sources.html](http://library.pdx.edu/citing_sources.html)

**In-class presentation.** You will present your class project in-class in the finals/11<sup>th</sup> week. Plan for a 15-minute presentation.

***Late assignments will be marked down – one-third of a grade per day late.*** “One-third of a grade” is, for example, from A to A-, B+ to B, etc. (or 3.3% using the scale below). As with incomplete grades, I generally do not allow students to turn things in late without assessing this penalty, except in unusual circumstances, e.g. medical emergencies. Having too much work in other classes or at work/internship does not count. All students have those challenges.

## Readings and Schedule

There are three texts for this course. You are not required to buy any of the textbooks. Most readings will be distributed via the course web site and I intend to cover the essential points in my lecture notes. However, it is highly recommended to get the last two texts if you plan to do work/research in this area.

1. *A Self Instructing Course in Mode Choice Modeling* (SIC), Prepared for U.S. Department of Transportation, F.S. Koppelman et al., January 31, 2006. This text is available for download from the following website:  
[http://www.ce.utexas.edu/prof/bhat/COURSES/LM\\_Draft\\_060131Final-060630.pdf](http://www.ce.utexas.edu/prof/bhat/COURSES/LM_Draft_060131Final-060630.pdf)
2. *Discrete Choice Methods with Simulation* (TRAIN) by Kenneth Train (2009 edition) published by Cambridge University Press. I highly recommend you buy a paperback copy of this book, which may be purchased through many online retailers. A free version for academic use is also available via Kenneth Train’s website:  
<http://elsa.berkeley.edu/books/choice2.html>.
3. *Discrete Choice Analysis: Theory and Application to Travel Demand* (DCA) by Ben-Akiva and Lerman (1985 edition), available from The MIT Press, 55 Hayward Street, Cambridge, MA 02142, (1-800-356-0343 or [mitpress-orders@mit.edu](mailto:mitpress-orders@mit.edu)). You may also find it available from various online retailers (e.g. Amazon).

## Tentative Schedule

Topics covered may be adjusted based on progress and class interests.

### Week 1: Introduction and Choice Theory

#### Readings

- SIC, Chapters 1-3
- DCA, Chapter 3

## Week 2 Binary and Multinomial Logit Model

### Readings

- TRAIN, Chapters 2, 3;
- SIC, Chapters 4, 5
- DCA, Chapters 4 (skim) & 5

**Assignment Week2:** Homework 1 assigned

## Week 3. Model Specification Development and Testing

### Readings

- SIC, Chapter 6

**Assignment:** Initial class project proposal due.

## Week 4: Application of Discrete Choice Models for Analysis

Developing the model is only half the battle. In this section we'll discuss how to employ the model for analysis, including the use of elasticities, forecasting, and welfare analysis.

### Readings

- DCA, Chapter 6
- TRAIN, Chapter 3
- SIC2, Chapter 11

**Assignment:** Homework 1 due; Homework 2 assigned

## Week 5: Ordered Choice Models

### Readings

- Greene, W. 2008

**Assignment:** Class project updates due

## Week 6 Nested Logit and Generalized Extreme Value Models •

### Readings

- TRAIN, Chapter 4
- SIC2, Chapter 7
- DCA, Chapter 10 (Except Section 10.7)

**Assignment:** Homework 2 due; Homework 3 assigned

## Week 7: Mixed Logit Models; Random Parameter Choice Model

### Readings

- TRAIN, Chapter 6
- [Hensher and Greene, 2003](#)

## Week 8: Discrete Choice Model vs Machine Learning

### Readings

- [Brieman, 2001](#)
- [Hillelab, Bierlaire, Elshafiec, Jin, 2021](#)
- [Pineda-Jaramillo and Arbeláez-Arenas, 2022](#)

## **Week 9: Advanced Topics in Discrete Choice Modeling**

### **Readings**

- McFadden, 1978
- TRAIN, Chapter 6
- Walker and Ben-Akiva, 2011

**Assignment:** Homework 3 due

## **Week 10: Project workshop**

## **Finals Week: Class project presentation + Final paper due**

## **ACCESS AND INCLUSION FOR STUDENTS WITH DISABILITIES**

PSU values diversity and inclusion; My goal is to create a learning environment that is accessible, equitable, inclusive, and welcoming. I am committed to fostering mutual respect and full participation for all students. If any aspects of instruction or course design result in barriers to your inclusion or learning, please notify me. Additionally, the Disability Resource Center (DRC) provides reasonable accommodations for students who encounter barriers in the learning environment. The DRC works with students who have physical, learning, cognitive, mental health, sensory, and other disabilities.

If you have, or think you may have, a disability that may affect your work in this class and feel you need accommodations, contact the Disability Resource Center to schedule an appointment and initiate a conversation about reasonable accommodations.

If you already have accommodations, please contact me to make sure that I have received your faculty notification letter from the DRC so we can discuss your accommodations.

The DRC is located in 116 Smith Memorial Student Union, Suite 116. You can also contact the DRC at 503-725-4150 or, [drc@pdx.edu](mailto:drc@pdx.edu). Visit the DRC online at <https://www.pdx.edu/disability-resource-center>.

### **Title IX reporting obligations**

As an instructor, one of my responsibilities is to help create a safe learning environment for my students and for the campus as a whole. Please be aware that as a faculty member, I have the responsibility to report any instances of sexual harassment, sexual violence and/or other forms of

prohibited discrimination. If you would rather share information about sexual harassment, sexual violence or discrimination to a confidential employee who does not have this reporting responsibility, you can find [a list](http://www.pdx.edu/sexual-assault/get-help) (http://www.pdx.edu/sexual-assault/get-help) of those individuals. For more information about Title IX please complete the required student module [Creating a Safe Campus](#) in your D2L.