NORTHWESTERN UNIVERSITY Spring Quarter 2022

Transportation Systems Analysis and Planning Amanda Stathopoulos

CIV_ENV 395-0-29 Behavioral Choice Modeling in Engineering

Credits:	1
Room:	Technological Institute M120
Time:	M+W 10:00–11:50
Instructor's Office:	Tech, Room A312
TA/Grader:	TBA
Office Hours:	M 1:30 – 2:00 or by appointment
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New Course for 2022! Some changes may be done for the course plan and syllabus

Behavioral choice modeling provides a scientifically robust method to investigate and understand how choices are made in a variety of systems and contexts. In this course you will learn methods to conceptualize, design, implement and finds practical answers to choice modeling problems in a variety of settings, including transportation, energy, water, consumer science, health, food preferences, residential location and more. This course builds on a previously taught 400-level class which has been adjusted to a broader audience in 2022. In this new course students will learn behavioral theories and methods to study human decision-making in engineered and natural systems, how to estimate demand for innovative products and services, and how to quantify non-tangible effects. CEE-395 will equip students with tools to study the complexity of human decision-making processes that are influential in all disciplines of engineering and beyond. The course is designed to learn by doing creative and open-ended work, and students will get a chance to design their own study, collect data, and analyze findings.

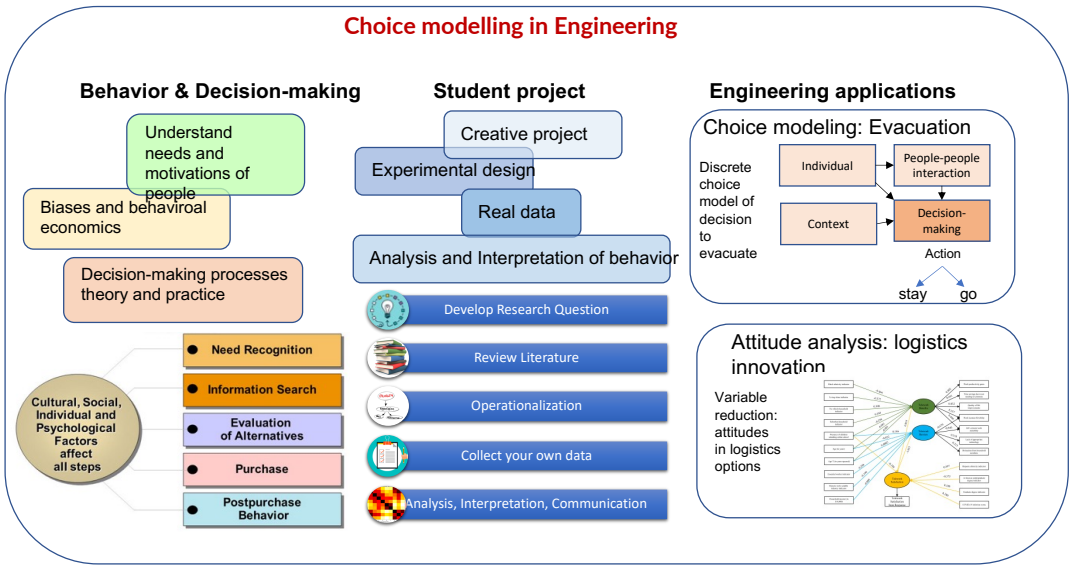
Who should take the class?

The audience for this course is upper-division undergraduate (Junior/Senior) and graduate students in Engineering and Sciences.

Prerequisites

Students need to have taken a statistics or probability class such as CIV-ENV306 (or equivalent). If you have questions about prerequisites email the instructor

Figure 1: Course outline



Course Description

In this course students will learn both theory and practice of behavioral choice modeling. The course is centered around a quarter long mini-research project where students learn about all the stages of independent research, covering the main stages of research, from formulating a research question, to experimental design, data-acquisition and analysis.

The course also covers the theory and practice of choice modeling, behavioral analysis, and latent variable analysis, using psychological constructs and factor analysis to better understand decision making processes that play an important role in engineering system impacts. To support application and 'learning by doing', the course will use R software and hands-on sessions to teach data-exploration, experimental design, logit modeling, and Exploratory/Confirmatory Factor modeling. The knowledge gained from this course is valuable for research and professional practice in planning, operations and management of engineered systems affected by human preferences, goals, attitudes and biases.

Course Objectives

1. Develop knowledge of the role of behavior and decision-making in students own disciplines
2. Foster creativity and autonomy in students by designing your own research project
3. Demonstrate understanding of the main theories and concepts in choice modeling (e.g. utility theory, behavioral economics, decision-making, attitudes, biases)
4. Develop hands-on skills in the main stages of behavioral research covering research question design, literature, experimental design, data-collection and modeling)

5. Develop skills in handling decision-making data and using relevant software to estimate and interpret simple choice models
6. Develop skills in using relevant methods to design and analyze attitudinal (latent variable) data
7. Demonstrate skills in effective audience-specific written, graphic/visual, oral and interpersonal communication related to choice models and research
8. Show critical thinking skills. In this course this is centered on: a) consideration of different theories, perspectives, explanations; b) ability to incorporate both qualitative and quantitative aspects in your project.

Course Format

Classes are combination of lectures, discussions, hands-on activities, and computer lab work. Students are expected to read assigned texts before class and to participate in class discussions and activities. Homework assignments will be given and analysis of these assignments will be the basis for some class discussion during the class immediately following their due date, so it is essential to complete assignments **on time**.

Course Schedule

Class will meet in M120 in TECH on Mon & Wed.[1]

There is no specific textbook in this class, but readings will come from papers and other sources An important part of our work in class will be from articles, plus distributed notes and supplemental readings posted on Canvas. Assigned readings for particular classes will be announced in advance, either in class or in the announcements section on Canvas. Students should check the Canvas 'study-guide' regularly for updates.

Evaluation

The grade is based on three main activities, namely attendance, class modeling home-works, and a larger class-long project. There will be no other final exam beyond the components listed here.

The class modelling projects are designed to learn the theory and practice of discrete choice modeling and attitude analysis and students will be assigned a dataset to work on for empirical modelling. A short report with the model results and interpretation will be handed in. Students may work in teams but each student will hand in their own report.

For the quarter-long research project students will propose their own investigation, and work on design, data-collection and analysis, with 4 main deliverables that reflect the different stages of maturation of the project. Each time, a week prior to report due-dates there is a check-in with the instructor for feedback and clarifications.

[1] There will be no class on Memorial day

Table 1: Class structure

	Percent of grade	Description
Class participation	10%	The class participation section of the grade does not just measure attendance in class, but also active participation as reflected through insightful questions and discussion in class.
Modelling projects with homework	30%	Two modellign class homeworks will be used to practice coding, running, interpreting and analyzing choice [15%] and attitudinal models [15%].
Mini research project with reporting	60%	Students will design an independent creative mini research project that runs through the entire course with 4 main deliverables: i) Define research question with literature support [report 10% grade] ii) design and implement a study (e.g. survey, behavioral test, natural experiment, etc) including design of questions, measurements, sampling, controls [report 20% grade]; iii) carry out qualitative or statistical analysis to respond to the research question. Results will be presented orally to class [10% grade] as a proposal presentation, and all stages of the project will be assembled and summarized in a mini-paper [20%]

Deliverables and grading

All assignments will be delivered in Canvas, preferable in pdf or doc(x) format. Keep in mind that given the focus on an independent project in the class high quality and thoughtful work is expected; leaving assignments to the last few hours before the deadline will likely not yield good results. The grading translation scheme is shown in Figure 1.

Late policy

- The cutoff for assignments is posted on Canvas (typically at midnight on the due date).
- Any late submissions will be assigned a penalty of 10% of the grade per day late. Assignments will not be accepted and graded past 3 days late.
- You are granted <u>two</u> 'no explanation needed' grace days for assignments. This means you can give yourself an extra day without penalty for graded assignments. I recognize that even careful plans can sometimes be derailed by illness, computer problems, theft, or personal situations. Students get to decide if and when to use the grace days, and you do not need to explain or notify me. This gives you the power to decide how to dispose of the grace days.
- Any grace days that remain at the end of the course will be used as a grade bonus.

Figure 2: Grading scheme (% to letter grades)

Grading Scale (% to letter grades)		
Percentage	Letter grades	Expected Performance
93 -100	A	Excellent
90 -92.9	A-	Very Good, very minor mistakes
86 -89.9	B+	Good
83 -85.9	B	Solid but some room for improvement
80 -82.9	B-	Consistent Issues
76 -79.9	C+	
73 -75.9	C	Significant weakness
70 -72.9	C-	
66 -69.9	D+	
63 -65.9	D	Passing but many failed elements/tasks
60 -62.9	D-	
0 -59.9	F	

Figure 3: Preliminary schedule

- Instructor granted extensions will only be considered after the grace days are used. Any extension beyond the grace day(s) are only for exceptional circumstances and need to be discussed and granted before the assignment is due.

Course outline and topics

This section will be added.

Office Hours

Office hours are held in tech A312. Questions are likely to arise in relation to independent work, and not on a regular schedule. As such, it is usually quickest to communicate questions and resolve issues via e-mail or ask for an appointment via mail a-stathopoulos@northwestern.edu E-mail responses can be expected within 24 hours.