CE 264
BEHAVIORAL MODELING
FOR ENGINEERING, PLANNING, AND POLICY ANALYSIS

Professor Joan Walker
Department of Civil and Environmental Engineering & Center for Global Metropolitan Studies
111 McLaughlin Hall
JoanWalker@Berkeley.Edu
510 642 6897

Many aspects of engineering, planning, and policy involve a human element, be it consumers, businesses, governments, or other organizations. Effective design and management requires understanding this human response. This course focuses on behavioral theories and the use of quantitative methods to analyze human response. A mix of theory and practical tools are covered, with applications drawn from infrastructure investment and use, urban growth and design, health, and sustainability.

Through case studies and a class project, you will gain hands on experience with behavioral theory, data collection, model development, and analysis. By the end of the course, you should be able to (1) employ quantitative behavioral analysis in your research and profession and (2) critically analyze models as you come across them throughout your careers.

This is a 3 unit graduate course. Undergraduate students can take the course subject to instructor approval. Basic statistics and calculus are prerequisites.

SCHEDULE

Topic 1: Intro to behavioral science in engineering, planning, & policy (1 week)

We begin by exploring behaviors of consumers, businesses, governments, and other organizations that influence engineering, planning, and policy issues. Examples will be discussed, including issues related to infrastructure investment and use, urban growth and design, health, and sustainability. An overview of the class will be presented, and theories of individual behavior from various disciplines (e.g., economics and psychology) will be introduced.

Readings

- Ben-Akiva M, Bierlaire M, McFadden D, Walker J (2015 draft) *Discrete Choice Analysis,* Chapter 1.
- Gaker D, Vautin D, Vij A, Walker J (2011) "The Power and Value of Green in Promoting Sustainable Transport Behavior," *Environmental Research Letters*.
- Thaler RH, Sunstein CR (2008) *Nudge: Improving Decisions About Health, Wealth, and Happiness*. Yale University Press, New Haven and London. Introduction and Chapters 1, 5, and 12.
- Nicholson W, Snyder CM (2007) *Microeconomic Theory: Basic Principles and Extensions*. South-Western College Pub. Chapters 3, 4.
- Ben-Akiva M, Lerman S (1985) *Discrete Choice Analysis*. MIT Press, Chapter 3.
  - OR - Ben-Akiva M, Bierlaire M, McFadden D, Walker J (2015 draft), *Discrete Choice Analysis,* Chapter 2.
- Math refresher notes, supplemented by your favorite probability, statistics, and calculus texts.

Topic 2: Introduction to Discrete Choice Analysis (4 weeks)

The fundamentals of discrete choice analysis will be presented, including a discussion of its power and limitations. Topics include derivation, properties, specification, estimation, and testing of binary and multinomial choice.

Readings

- Ben-Akiva M, Lerman S (1985) *Discrete Choice Analysis*. MIT Press. Chapters 4, 5, 7.
  - OR- Ben-Akiva M, Bierlaire M, McFadden D, Walker J (2015 draft) *Discrete Choice Analysis*. Chapters 4, 5, 6.
  - OR- Train K (2009) *Discrete Choice Methods with Simulation, Second Edition*. Cambridge University Press. Chapters 2, 3.
- McFadden D (2001) Economic Choices. *The American Economic Review* 91(3), 351-378.

Topic 3: Data collection (2 weeks)

The methods in this course often require in-depth surveys. In this section we'll study types of data (revealed preferences, stated preferences, conjoint, psychometric data), survey and experimental design, and issues of sampling.

Readings

- Ben-Akiva M, Bierlaire M, McFadden D, Walker J (2015 draft) *Discrete Choice Analysis*, Chapter 3.
- Rea LM, Parker RA (2005) Designing & Conducting Survey Research: A Comprehensive Guide. 3rd Edition. Jossey-Bass, Chapters 2 and 3.

Topic 4: Application of discrete choice models for analysis (2 weeks)

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

- Ben-Akiva M, Lerman S (1985) *Discrete Choice Analysis*. MIT Press. Chapter 6.
  - OR - Ben-Akiva M, Bierlaire M, McFadden D, Walker J (2015 draft) *Discrete Choice Analysis*, Chapter 10.
  - OR - Train K (2009) *Discrete Choice Methods with Simulation, Second Edition*. Cambridge University Press. Chapter 3.

Topic 5: Advanced discrete choice analysis (4 weeks)

Discrete choice analysis goes far beyond the multinomial logit models emphasized above. In this section, we'll cover some of the most important and practical extensions, including nested logit and GEV, mixed logit, combining datasets, and choice models with latent variables.

Readings

- Ben-Akiva M, Lerman S (1985) *Choice Analysis*. MIT Press. Chapter 10.
- Train K (2009) *Discrete Choice Methods with Simulation, Second Edition*. Cambridge University Press. Chapters 4, 6, 7.
- Ben-Akiva, M., Bradley, M., Morikawa, T., Benjamin, J., Novak, T., Oppewal, H., and Rao, V. (1994), "Combining revealed and stated preferences data," Marketing Letters, Vol. 5, No. 4, pp. 335-349.
- Walker JL, Ben-Akiva M (2011) Advances in Discrete Choice: Mixture Models. In Handbook in Transport Economics (Eds, de Palma, Lindsey, Quinet, Vickerman).
- Vij, A., J.L. Walker, "Preference Endogeneity in Discrete Choice Models," Transportation Research Part B, 2014, 64, 90-105.
- Paulssen, M., D. Temme, A. Vij, and J.L. Walker, "Values, Attitudes and Travel Behavior: A Hierarchical Latent Variable Mixed Logit Model of Travel Mode Choice," Transportation, 2014, 41(4), 873-888.

READINGS

There are three main texts:

- Ben-Akiva and Lerman (1985)
- Train (2009)
- Ben-Akiva, Bierlaire, McFadden and Walker (2015, working), which is the draft of major update to Ben-Akiva and Lerman (1985)

On many topics, these texts are somewhat interchangeable. Train (2009) is available for free online (http://elsa.berkeley.edu/books/choice2.html) or you can purchase a hardcopy. Ben-Akiva and Lerman (1985) is on reserve in the ITS library (4th floor of McLaughlin) and you can purchase a hardcopy. The draft text and other readings will either be handed out in class, made available through bCourses, or a URL will be provided. Note that the reading list is tentative and adjustments may be made.

COURSE REQUIREMENTS AND GRADING

- Problem sets (30%)
  7 problem sets, 6 of which use real data and require specification, estimation, and application of a behavioral model. The problem sets also include supplemental problems to work through. The assignments are spaced every 2 weeks in the course. The problem sets are as follows and are scheduled as noted on the next page:
  - PS1: Behavior and policy
  - PS2: Binomial choice
  - PS3: Multinomial choice
  - PS4: Model application and forecasting
  - PS5: Models with flexible error structures
  - PS6: Models with random taste heterogeneity
  - PS7: Integrated choice and latent variable models

  Assignments are due in class or can be handed in to Joan Walker's mailbox in 106 McLaughlin.

- One in-class exam (35%) on Thursday April 2.

- Group project (35%)
  Design and execute behavioral analysis for an engineering, planning or policy strategy. Deliverables are a paper ("TRB style", <7500 words) and a poster presented at the poster session the Thursday of reading week. The early problem sets will contain questions to get you thinking about the projects. The project has the following deadlines to keep you on track:
  - by Thursday, Feb 19 * Submit 1 pager with group members and project idea(s) & Meeting #1 with either Timothy and/or Joan re project
  - by Thursday, Mar 5 * Meeting #2 with either Timothy and/or Joan re project (optional, but advised)
  - by Thursday, Mar 19 * Sketch of model and Draft survey (or data description) due & Meeting #3 with either Timothy and/or Joan re project
  - Thursday, Apr 9 Submit 1 pager with project update. At this point you should have your data in hand.
  - Thursday, Apr 23 Draft paper due
  - Thursday, May 7 Poser session and final paper due

  * at least one of these three meetings must be with Joan

Despite what the official Berkeley schedule of classes says, there is no final exam in this course.

SOFTWARE

We'll be using the estimation software *Python Biogeme* by Michel Bierlaire (EPFL, Switzerland). It is available for free on the web at *http://biogeme.epfl.ch/*. It runs on both Windows and Mac.

COURSE WEBSITE

BCourses

SCHEDULE OF THE MAIN EVENTS

(May be adjusted as necessary)

DATE			SPECIAL EVENTS	PS OUT	PS IN	PROJECT DELIVERABLE
Tue	Jan	20		1		
Thur	Jan	22				
Tue	Jan	27				
Thur	Jan	29				
Tue	Feb	3	Tuesday PS deadline	2	1	
Thur	Feb	5				
Tue	Feb	10				
Thur	Feb	12		3	2	
Tue	Feb	17				
Thur	Feb	19				Mtg #1 and 1 Pager: Project team and ideas
Tue	Feb	24				
Thur	Feb	26		4	3	
Tue	Mar	3				
Thur	Mar	5				Mtg #2 (optional)
Tue	Mar	10				
Thur	Mar	12		5	4	
Tue	Mar	17				
Thur	Mar	19				Mtg #3 and Draft Survey/Data Description
~~Tue~~	~~Mar~~	~~24~~	Spring break			
~~Thur~~	~~Mar~~	~~26~~	Spring break			
Tue	Mar	31	Tuesday PS deadline		**5**	
Thur	Apr	2	**EXAM**	6		
Tue	Apr	7				
Thur	Apr	9				1 Pager: Project update; data collected
Tue	Apr	14				
Thur	Apr	16		7	6	
Tue	Apr	21				
Thur	Apr	23				Draft paper due
Tue	Apr	28				
Thur	Apr	30			7	
Tue	May	5	RRR - No class			
Thur	May	7	**RRR - Project presentations in class**			**Final paper and poster due**