

UP 431: Urban Transportation Modeling

Spring 2021, Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign

CLASS MEETINGS: Tuesday and Thursday, 3:30 – 4:50 pm, Zoom

INSTRUCTOR: Bumsoo Lee, bumsoo@illinois.edu

OFFICE HOURS: 2:30 – 3:20 pm on Tuesday and by appointment, Zoom

TEACHING ASSISTANT: Chaeyeon Han, ch55@illinois.edu

Office hours: 2:30 – 3:20 pm on Monday and by appointment, Zoom

COURSE OVERVIEW

“All models are wrong; some are useful.” –George Box

This course provides the basic skills needed to understand how planners and decision makers can use information about travel behavior to plan transportation investments. Travel demand models often support these decisions and have an air of authority because they produce precise estimates of trip-making patterns. But how the models translate inputs to outputs is often opaque and relies on assumptions that may or may not mirror reality. While you will learn practical skills in travel demand modeling applications in this course, you will also learn to understand and critique these models using knowledge of travel behavior theory, methods, and problem-solving skills.

Learning objectives

By the end of the course, you will be able to:

- Apply behavioral theory and discrete choice analysis to understand travel behavior
- Describe transportation data sources and collection methods
- Explain how travel demand models work
- Critique transportation models and their outputs
- Analyze planning scenarios using travel demand modeling software

COURSE AT A GLANCE

Week	Dates	Topic	Assignment Due
1	Jan 26, 28	Introduction; Travel behavior fundamentals	
2	Feb 2, 4	Transportation data collection	
3	Feb 9, 11	Transportation data analysis	Assignment 1 (Feb 11)
4	Feb 16, 18	Discrete choice analysis	
5	Feb 23, 25	Discrete choice analysis	Assignment 2 (Feb 23)
6	Mar 2, 4	Modeling software and TDM; Guest lecture	
7	Mar 9, 11	Trip generation	Assignment 3 (Mar 9)
8	Mar 16, 18	Trip generation & distribution	
9	Mar 23, 25	Trip distribution	
10	Mar 30, Apr 1	Mode choice	
11	Apr 6, 8	Trip assignment	
12	Apr 15	Model validation; Related models (MOVES/ITHIM)	Assignment 4 (Apr 15)
13	Apr 20, 22	Evaluating alternatives	
14	Apr 27, 29	Model critiques & emerging applications	
15	May 4	Final presentations	Final project (May 10)
16		<i>Finals week</i>	Grad term paper (May 14)

PREREQUISITE

UP 430 or CEE 417, or consent of instructor, Junior standing required.
Familiarity with basic statistics and R program will be helpful for the success in UP 431.

All students are **STRONGLY** encouraged to attend “**Introduction to R for Planners 2-day workshop**” on Jan 30 and Feb 6, 9am-2pm. For more information on the workshop, <https://urban.illinois.edu/about-us/events/introduction-to-r-for-planners-2-day-workshop/> Please register here: <https://illinois.zoom.us/meeting/register/tZUvdOqqzkoE9EXd75j8KOgpOB5eWrmU3KW>

EVLUATION

	Undergraduate students	Graduate students
Assignments (1/4 each)	60 %	40 %
Final project	30 %	30 %
Term Paper	-	20 %
Participation and attendance	10 %	10 %

RUBRIC: A: Demonstrates original thought and synthesis of ideas and cogent analysis, and is clearly written and presented. Outstanding work.
B: Presents above average analysis with appropriate evidence to support ideas, and is clearly written or presented. Good work.
C: Shows a basic level of understanding, with analysis limited to obvious arguments. Writing is competent. Adequate work.
D: Misunderstands or misrepresents the material, or is so poorly written or presented as to obscure the analysis. Inadequate work.

Transformation of numerical grade to letter grade will be according to the schedule below:

A+	97-100		
A	93-96.9	C+	77-79.9
A-	90-92.9	C	73-76.9
B+	87-89.9	C-	70-72.9
B	83-86.9	D+	67-69.9
B-	80-82.9	D	60-66.9

POLICIES

SPECIAL ACCOMMODATIONS This course will accommodate students with documented disabilities. Please refer to <http://disability.illinois.edu/disability-resource-guide> for more information and provide the appropriate documentation at the beginning of the semester.

ACADEMIC INTEGRITY This course follows the guidelines set forth by the University student code. See http://studentcode.illinois.edu/article1_part4_1-401.html for specific guidelines, examples, and punishment associated with academic dishonesty.

CLASS CLIMATE The Department of Urban and Regional Planning (DURP) is committed to creating an environment of inclusion and opportunity that is rooted in the very

goals and responsibilities of practicing planners. Conduct that interferes with the rights of another or creates an atmosphere of intimidation or disrespect is inconsistent with the environment of learning and cooperation that the program requires. By enrolling a course in the Department of Urban and Regional Planning, students agree to be responsible for maintaining a respectful environment in all DURP activities, including lectures, discussions, labs, projects, and extracurricular programs. We will be governed by the University Student Code. See Student Code Article 1—Student Rights and Responsibilities, Part 1. Student Rights: §1-102 In the Classroom.

EMERGENCY
RESPONSE
RECOMMENDATIONS

The Department of Homeland Security and the University of Illinois at Urbana-Champaign Office of Campus Emergency Planning recommend the following three responses to any emergency on campus: **RUN > HIDE > FIGHT**
For more information, <http://police.illinois.edu/emergencyplanning/general/>

COUNSELING CENTER

The Counseling Center is committed to providing a range of services intended to help students develop improved coping skills in order to address emotional, interpersonal, and academic concerns. The Counseling Center provides individual, couples, and group counseling. All of these services are paid for through the health services fee. The Counseling Center offers primarily short term counseling, but they do also provide referrals to the community when students could benefit from longer term services.
<https://counselingcenter.illinois.edu/>

COURSE SCHEDULE

Note: **TDF** = National Academies of Sciences, Engineering, and Medicine. 2012. *Travel Demand Forecasting: Parameters and Techniques*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/14665>.

Week 1: Introduction to travel demand models and planning; travel behavior fundamentals

Miller, Harvey J. 2017. “5. Theories and Models in Transportation Planning.” In *The Geography of Urban Transportation*, edited by Genevieve Giuliano and Susan Hanson, 4th ed., 113-138. New York and London: The Guilford Press.

[Optional] “7. Land Use, Travel Behavior, and Disaggregate Travel Data.” In *The Geography of Urban Transportation*, edited by Genevieve Giuliano and Susan Hanson, 4th ed., 113-138. New York and London: The Guilford Press.

Weeks 2 & 3: Transportation data collection and analysis

TDF, Chapter 3. Data needed for modeling, pp. 14-26.

Federal Highway Administration. 2018. Chapters 1-3 in *2017 NHTS Data User Guide*. Washington DC: US Department of Transportation. <https://nhts.ornl.gov/assets/2017UsersGuide.pdf>

Week3 - Pindyck, R. S. and D. Rubinfeld. 2009. *Microeconomics 7th ed.* Upper Saddle River, NJ: Pearson. Appendix The basics of regression. pp. 687-694.

[Optional] de Dios Ortúzar, Juan, and Luis G. Willumsen. 2011. “Data and Space” (Chapter 3). In *Modelling Transport*. West Sussex, UK: Wiley. [Available as e-book from the University Library.]

[Optional] Welch, S. and J. Comer. 2006. *Quantitative Methods for Public Administration: Techniques and Applications 3rd ed.* Long Grove, IL: Waveland Press. Chapters 8 & 9, pp. 212-259.

Weeks 4 & 5: Introduction to discrete choice analysis

Levinson, David, et al. n.d. "Choice Modeling." In *Fundamentals of Transportation*. Wikibooks.
https://en.wikibooks.org/wiki/Fundamentals_of_Transportation/Choice_Modeling.

Koppleman, Frank S., and Chandra Bhat. 2006. Chapters 3 & 4 in *A Self Instructing Course in Mode Choice Modeling: Multinomial and Nested Logit Models*.
http://www.cae.utexas.edu/prof/bhat/courses/lm_draft_060131final-060630.pdf

[Optional] Kahneman, Daniel. 2011. "Bernoulli's Errors" and "Prospect Theory" (Chapters 25-26). In *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.

[Optional] Thaler, Richard H., and Cass R. Sunstein. 2009. "Biases and Blunders" (Chapter 1). In *Nudge*. New York: Penguin.

Week 6: Introduction to modeling software

Sciara, Gian-Claudia and Susan Handy. 2017. "6. Regional Transportation Planning." In *The Geography of Urban Transportation*, edited by Genevieve Giuliano and Susan Hanson, 4th ed., 113-138. New York and London: The Guilford Press.

Review Citilabs Learning Center for relevant resources. <http://www.citilabs.com/support/learning-center/>.

Miller and Meyer. 2001. "Demand Analysis" (Chapter 5). In *Urban Transportation Planning*, 2nd edition. New York: McGraw-Hill. [Come back to this over the next 5 weeks.]

[Optional] MTC ABAG (SF Bay Area) Analytical Modeling Wiki.
<https://github.com/BayAreaMetro/modeling-website/wiki>.

Week 7 & 8 (Mar 16): Trip generation

TDF, Sections 4.3 and 4.4.

[Optional] Chapter 4 in *Modelling Transport*.

Week 8 (Mar 18) & 9: Trip distribution

TDF, Sections 4.5 and 4.6.

[Optional] Chapter 5 in *Modelling Transport*.

Week 10: Mode choice

TDF, Section 4.7

[Optional] Chapter 6 in *Modelling Transport*.

Week 11: Trip assignment

TDF, Sections 4.8, 4.9, 4.11, and 4.12.

[Optional] Chapter 10 in *Modelling Transport*.

Week 12: Model validation; Air quality models and health impact modeling

TDF, Chapter 5. Model validation and reasonableness checking

Chicago Metropolitan Agency for Planning. 2018. *On To 2050 Air Quality Conformity Analysis*. <https://www.cmap.illinois.gov/documents/10180/911391/FINAL+Air+Quality+Conformity+Analysis+Appendix.pdf/3e783c96-1005-44d1-5b87-9564a8fbca27>.

Review the EPA MOVES website (<https://www.epa.gov/moves>), especially the MOVES2014a training: <https://www.epa.gov/moves/moves2014a-introduction-and-new-features-december-2015-webinar-slides>.

Woodcock, James, Moshe Givoni, and Andrei Scott Morgan. 2013. "Health Impact Modelling of Active Travel Visions for England and Wales Using an Integrated Transport and Health Impact Modelling Tool (ITHIM)." *PLOS ONE* 8 (1): e51462. <https://doi.org/10.1371/journal.pone.0051462>.

Week 13: Evaluating alternatives

Miller and Meyer. 2001. "Transportation System and Project Evaluation" (Chapter 8). In *Urban Transportation Planning*, 2nd edition. New York: McGraw-Hill.

Federal Highway Administration. 2019. "Assessing Benefits and Burdens of Plans and Programs." In *Environmental Justice Analysis in Transportation Planning and Programming: State of the Practice*. 61-88. https://www.fhwa.dot.gov/environment/environmental_justice/publications/tpp/index.cfm.

Week 14: Model critiques and emerging applications (Activity-based models, integrated models, microsimulation, big data)

Cervero, Robert. 2006. Alternative approaches to modeling the travel-demand impacts of smart growth. *Journal of the American Planning Association*, 72 (3), 285-295.

TDF, Chapter 6. Emerging modeling practices

[Optional] Lowe, Kate, and Kim Mosby. 2016. "The Conceptual Mismatch: A Qualitative Analysis of Transportation Costs and Stressors for Low-Income Adults." *Transport Policy* 49 (July): 1–8. <https://doi.org/10.1016/j.tranpol.2016.03.009>.

[Optional] Waddell, Paul, Geoff Boeing, Max Gardner, and Emily Porter. 2018. "An Integrated Pipeline Architecture for Modeling Urban Land Use, Travel Demand, and Traffic Assignment." arXiv:1802.09335. Retrieved from <https://arxiv.org/abs/1802.09335#>.

[Optional] Bliss, Laura. 2019. "Why Real-Time Traffic Control Has Mobility Experts Spooked." *CityLab* (July 19). <https://www.citylab.com/transportation/2019/07/digital-twin-mobility-data-standard-city-real-time-traffic/593914/>. [Also on Compass in case *CityLab* articles get rearranged or removed.]

Week 15: Final project presentations