CEE 371: Introduction to Transportation Planning and Analysis & CEE 479: Transportation Systems Planning and Management

Instructor: Amanda Stathopoulos; Department of Civil and Environmental Engineering

- **Credits**: 1 Unit credit; Two lectures/week plus discussion section for 479 students
- **Instructor**: Amanda Stathopoulos, PhD
- **Instructor email:** a-stathopoulos@northwestern.edu
- **TA**: Gretchen Bella
- **TA email**: gretchen.bella@northwestern.edu
- **Schedule**: Monday, Wednesday 2pm-4pm, selected Fridays 2-4pm
- **Textbook**: No Formal Textbook, readings are assigned on Canvas
- **Location**: Technological Institute L170
- **Office hours**: 12.30-1.30pm Wednesdays in the instructor's Office: Tech A312
- **Canvas link:** to be added
- **Prerequisites**: None
- **Course requirement**: CEE371 is an elective part of the CEE Major Requirements: Civil Engineering Breadth. CEE479 is a required part of the core classes for the graduate degree (MS or Ph.D.) in Transportation Systems Analysis and Planning.
- **Canvas page**: TBD
- **Study guide – updated links to reading and preparation material**: TBD

Course description

In these merged courses we will study the characteristics, functions, organization, operations, and planning of passenger and freight transportation systems, both urban and intercity facilities and services. We will discuss some history and explore contemporary and emerging transportation issues from the perspective of planning and analysis methods and considering sustainability, equity, and resilience. We will learn some useful tools for analysis, problem solving and service design, including elements of travel forecasting, network analysis, data analysis and sources, and transportation service design.

We will devote some time to examining how transportation has been and can be used to allocate benefits – and negative impacts – across different places and demographic groups. My objective is for you to gain a strong sense of the systems, processes, benefits and costs of transportation, the professional challenges in the field, as well as to ignite your curiosity to learn more. Transportation analysis is a highly interdisciplinary effort and we will investigate how land-use, law, history, behavior, economics, urban design, and other disciplines intersect with our work in this class.

We will find that transportation is more than cars on a freeway or people riding a CTA bus. It facilitates life as we know it, defines where – and how – people live, work, and shop, supporting a diverse and dispersed economy, consuming vast amounts of money, time, energy, and environmental resources in the process.

Instructors

I have been at Northwestern since 2014 and have been teaching a module in CEE371/479 for eight years. I am excited to take over the whole class in 2023 after the retirement of Prof. Schofer. My research is in the area of travel demand, new forms of mobility, and modeling of decisions and I hope to guide you through the complexity and multidisciplinarity of transportation analysis and planning in this class, and awaken your curiosity in the role that transportation plays in meeting a range of community and governance goals. With this goal in mind we have designed a new activity for the class build on observing the reality of transportation systems. We are very fortunate to have **Gretchen Bella**, a doctoral student in

the transportation program, as our Teaching Assistant. Gretchen has experience with engineering practice as well as a degree from UT Austin in transportation engineering. You will find her to be knowledgeable, and supportive, and passionate about researching various transportation problems related to equity, health and big data.

Operations. We're bundling CEE 371 (undergrad) and 479 (grad) together to share lectures/discussions, but 479 students will get different homework and exam questions and will be graded separately, and they will have several dedicated Friday lab sessions that will be used for discussions.

The current plan is for the entire class to be held Mondays and Wednesday from 2:00 until 3:50. There will be a separate lab session for 479 students only held on selected Fridays, to be announced in advance, from 2:00 until 3:50. In this session we will discuss some relevant research and policy papers, as well as contemporary transportation planning issues. Topics will be announced in advance and all students are welcome to attend.

Interaction and engagement. This class will be interactive – during lectures I expect you to answer questions and to ask yours, to bring ideas to class, and to explore and share issues on your own. We will learn together through lectures, in-class problem-solving, and discussions, individual and team-based homeworks, as well as lab activities.

Preparation/textbook. The class has no single textbook but relies on various articles, reports, videos, podcasts, and visuals to support learning. The **Canvas study guide** gives a detailed listing of class activities and materials covered for each lecture. Class meetings will focus on shorter instruction activities along with application, critical thinking, or interactive discussions around the class topics. Therefore, students need to stay up to date with their preparation and go over announced material in advance to get the most out of classes. In parallel, there will be student activities organized on Canvas to consolidate concepts, analyze case studies or contextualize learning

Course goals and learning objectives. This course is informed by the idea that effective urban interventions require knowledge about the core issues, their analytical representations as well as the surrounding environment in terms of governance and technological developments. The overall **course goal** is to prepare students to become effective and sensible leaders in the Smart City era. By attending this class students will learn about theories, tools, and perspectives needed to understand smart city interventions from a broader societal perspective. Students will gain insights and skills on how to critically evaluate interventions designed to improve life in cities, including infrastructure design, and digital, behavioral, and technological measures.

The key **learning goals of this class are:**

1. Students will demonstrate **knowledge** of the basic theories and facts of transportation planning. This includes an ability to analyze the transportation planning process and stakeholders, assess competing goals and methods of transportation planning, understand the past, present and future of planning for different modes, geographies, and community needs. This goal is consistent with ABET Program outcomes number 7.
2. Identify and describe suitable **engineering solutions** to transportation planning and analysis challenges. This includes interpreting and using travel demand

results, interpreting shortest path algorithms, design of complete streets, or analyzing household travel data to inform policy-making. This goal is consistent with ABET Program outcomes number 6.

3. Clearly **communicate** information in written and oral formats. Students will show ability to produce engineering memos and other written material balancing technical and practical content suitable to different audiences. This goal is consistent with ABET Program outcomes number 3.
4. Skills in **teamwork**. Students will show the ability to work effectively in teams. This is centered on demonstrating: a) participation in group decision-making and coordination, b) prioritizing team project plans, schedules, and equitable management of people, c) coordinated joint deliverable of reports and oral presentations. This goal is consistent with ABET Program outcome number
5. Develop **critical thinking skills for transportation**. In this course this is centered on: a) consideration of different perspectives, stakeholders, and trade-offs; b) consideration of the problem/technology implementation context; and c) ability to incorporate both qualitative and quantitative aspects in your work, d) understanding the limitations technological solutions and avoid pitfalls
6. Students will foster creativity and curiosity about investigations surrounding transportation problems and solutions, and connect knowledge to their own area of expertise.

Table 2. Goals and assessment overview

Course goals	ABET outcomes	Criteria met via	Performance indicator	Assessment	Proposed Action
1 - **knowledge**	7	Midterm Exam, Final exam, Homeworks * 3	Result on entire Exams and Homework	tbd	tbd
2: **apply engineering analysis**	6	Midterm Exam, Final exam, Homeworks * 3, Team field-work project 1&2	Result on entire Exams and Homework	tbd	tbd
3: **communication**	3	In-class discussions, Team field-work project 1&2, Midterm Exam, Final exam, Homeworks * 3	In-class engagement, Result on entire Exams and Homework, delivery of Team field-work memo and presentation	tbd	tbd
4: **teamwork**	5	Team field-work project (2 deliverables)	Delivery of team report and oral presentations	tbd	tbd
5: **critical thinking**	2	In-class discussions, Midterm Exam, Final exam,	Select questions in Exams and in-class discussion	tbd	tbd

6: **creativity and curiosity**	na	In-class discussions, Team field-work project			

Student assessment

The examination is based on a diverse set of activities designed to foster an understanding of current theories, issues, and empirical cases of transportation planning, and allow students to evaluate competing solutions to transportation challenges from the perspective of policy and planning.

- The **homeworks** will involve tasks such as reflecting on readings, commenting on transportation data analysis and results, and applying engineering solutions, and answering questions in writing. Students will have 1-2 weeks to deliver homework on canvas. Students can upload a typed or handwritten document containing writing/drawings/calculations in response to the homework question.
- The **team-based project** is designed as a field-based observation of an intersection followed by a proposed design. Students will deliver two memos coupled with in-class presentation and discussion.
- The **written midterm** and final will be done in person using pen and paper. No computers are allowed but students can bring hand-written notes to the exam.
- All (updated) dates and deadlines will be posted on canvas in advance.

Table 3. Assessment and grading overview

Task	Description of graded activities	Share of the final grade	Graded as
Participation & Engagement in classroom discussion	Both attendance and class engagement will count – I will call on you if you do not volunteer to speak in class.	10%	Letter-grade
Mid-term exam	A written in person exam. No computers allowed (handwritten). Students can bring 2 sheets of notes	20%	Letter-grade
Final exam	A written in person exam (handwritten). No computers allowed. Students can bring 4 sheets of notes	20%	Letter-grade
3 Homeworks	3 written homework assignments will be administered. See schedule in study guide on Canvas	25%	Letter-grade
Team project: real world observation and presentation	2 team-based presentations of observation and design ideas for a real intersection (half grade associated with memo, half grade associated with the oral presentation)	25%	Letter-grade

The grading will align with the following expectations for performance.

Table 4. Grading expectations

Lettergrade	Points	Percent	Expected performance
A	4	94-100%	Mastery: Sophisticated understanding of material and methods

A–	3.7	90-94%	Excellent performance
B+	3.3	87-90%	Very Good
B	3	84-87%	Solid but some room for improvement
B–	2.7	80-84%	Consistent issues
C+	2.3	77-80%	
C	2	74-77%	Significant weakness
C–	1.7	70-74%	
D	1	60-70%	Passing, but many failed tasks
F	0		No Pass grade

Attendance policy

Attendance in the class sessions and team discussions is essential since that is where we do active learning, discussion, reflection, and work through examples and case studies. If you are unable to attend please let me know as soon as possible so I can make sure you get support and instructions for alternative assessment modes. Please send me an email as soon as you can titled 'CEE371/479 Absence'. Please do not come to class if you are experiencing symptoms of illness.

For a missed class make sure you catch up on readings and lecture material by talking to classmates and checking Canvas. More than 2 missed classes require that you contact me for a meeting to discuss further so that I can make sure you stay on track.

Late policy and grace days

The date and cutoff time for all assignments listed in table 3 are posted on Canvas (most assignments are due at midnight but some are due ahead of class time). Any late submissions will be assigned a penalty of 10% of the grade per day late.

You are granted **one** 'no explanation needed' **grace day** only for the **Homeworks**. This means you can give yourself an extra day without penalty. 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 day, and you do not need to explain or notify me. Instructor-granted extensions will only be considered for exceptional circumstances and students need to be diligent about communicating this as soon as possible.

Class topics outline

Below is the tentative schedule for the quarter. It will almost certainly change, mostly through shifts in the schedule of topics. Deliverable dates are due dates. Please use Canvas as the main guide for topics, deadline and preparation for class.

	Monday	Wednesday	Friday
Week 1	No class	Class overview; Introductions; Transportation planning fundamentals; All-class exploration of contemporary transportation issues and problems.	

Week 2	Transportation planning fundamentals; brief history of transportation engineering and planning; Agencies and stakeholders; Federal mandates and motivations. Process steps. Moving people vs. moving cars? * start of team project	Introduction to travel forecasting for transportation planning: prediction or planning? 4-step planning process; modeling & forecasting; planning goals; trip generation approaches and uncertainties; gravity model overview of mode choice; Overview of activity-based models	
Week 3	All students @ Transportation library **Transportation data**: sources, uses, trends. ACS, NHTS, regional travel surveys, real- time tracking data, privacy issues, value of data Introduction to student projects.	**Transportation data hands on lab**; linking demographics to travel choices; deriving trend to inform modeling and forecasting	Grad students Friday Discussion Modeling under Uncertainty: The TMIP approach * HW1 due "gravity model"
Week 4	**Behavioral models**; Stated and revealed data-collection; introducing the logit demand model, rational agent and alternative frameworks; Complexity vs realism.	Logit model **derivation and application**; random utility modeling; maximum likelihood estimation; selecting models and model fit.	All student teams; check in with instructor/TA
Week 5	**L**ogit model forecasting case-study; **walk-through of results**. Forecasting scenarios, elasticities & willingness to pay; Equity analysis in forecasting models; Equity versus Accessibility * Team memo 1 due	**Transit and equity (cont)** Equity considerations: meaning of equity for transportation: mobility vs. accessibility; allocation of costs and benefits; Transit – technologies, roles, and utilization, Wed competitiveness with the auto; essential workers and no-choice riders	* HW2 due trip making model interpretation
Week 6	All students *Student team presentation on intersection observation (8 teams) traffic counts and other reporting. Feedback and discussion	The **freight** industry and supply chains – Amazon and beyond; e-commerce and structure of the industry; **city logistics policies**	Grad students Friday Discussion **Free transit pros and cons discussion**
Week 7	All students NUTC Ruan *MIDTERM WRITTEN EXAM	**Network representation and analysis**: minimum path finding and equilibrium assignment. Methods and assumptions. Data requirements, sources, and collection methods. Use in operations management **Gretchen Bella**	
Week 8	**New mobility ideas:** non-motorized travel, app-based & on-demand; Mobility as a Service: MAAS and smart cities; Automation & Sharing economy	**Resilience and disruptions;** Measuring and designing for transportation; Restorations vs prevention; Natural hazards, resilience options, metrics; preparing and reacting; 4-r; Natural Hazards and Climate change	* HW3 due: network model All student teams; check in with instructor/TA
Week 9	**New planning concepts,** post-covid city, accessible, equitable transportation	traffic safety; complete streets; new research and policy recommendations **Prof. Schofer Guest lecture**	Grad students Friday Discussion **Congestion pricing in the US**
Week 10	**Slack-day, student proposed topics** * Team memo 2 due	No class □ Thanksgiving vacation begins	

Week 11	Student presentation of design ideas (8 team presentation). Feedback and discussion	**Wrapping up of class; joint reflection**	
Week 12 (exam week)	All students NUTC Ruan *Final Written exam		

Accessibility

Northwestern University is committed to providing the most accessible learning environment possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: accessiblenu@northwestern.edu; ph: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the quarter, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

Support for Wellness and Mental Health

I am committed to supporting the wellness of NU students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please let me know, and reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS), Religious and Spiritual Life (RSL), and the Center for Awareness, Response, and Education (CARE). Additional information on all of the resources mentioned above can be found here:
https://www.northwestern.edu/counseling/
https://www.northwestern.edu/religious-life/
https://www.northwestern.edu/care/

Acknowledgement. This coupled class was taught by Professor Joseph Schofer for several decades. The current course design is inspired by the structure he used for teaching and I have benefitted from guidance and material to use for my teaching of the class in 2023.