11.024 / 11.324 Modeling Pedestrian Activity in Cities: Towards Sustainable Mobility and City Design in Boston.

Fall 2026

MIT DUSP

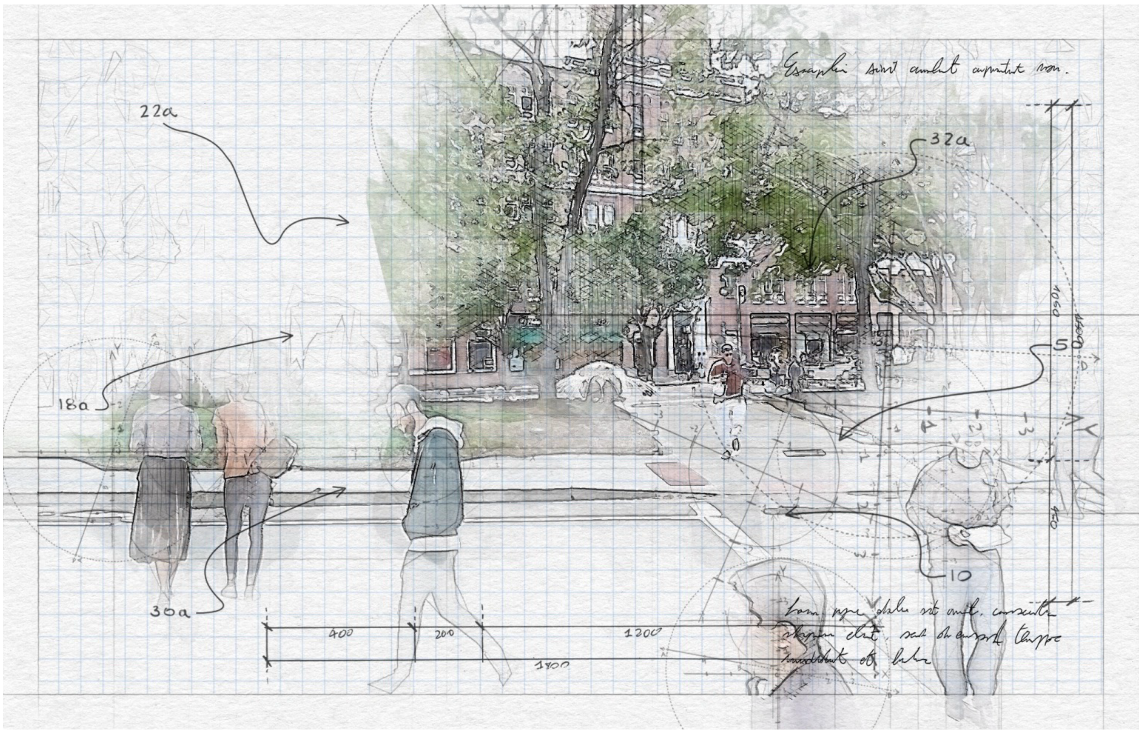

Image: MIT TECHNOLOGY REVIEW

Instructors
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asevtsuk@mit.edu

Weekly Schedule
Tuesday and Thursdays 2.00-3.30PM in W41-1219 (urban science computer lab)

First Class
Thursday, September 10th

Enrollment limit
Due to the lack of a TA, this course is limited to 12 participants. Applicants should prepare a short statement, cv, and if available, a portfolio of prior work. These materials should be emailed to asevtsuk@mit.edu

Course Description
This course investigates the interaction between pedestrian activity, urban form, street design, and land-use patterns. Informed by recent literature on pedestrian mobility, behavior and biases, we take a hands-on view and learn how to operationalize and model pedestrian activity in the built environment using software tools and analysis methods. Rather than engaging in comprehensive travel demand modeling across all modes, we use simplified, yet powerful and scalable Urban Network Analysis (UNA) methods that focus uniquely on pedestrians. Emphasis is placed on not only modeling or predicting pedestrian

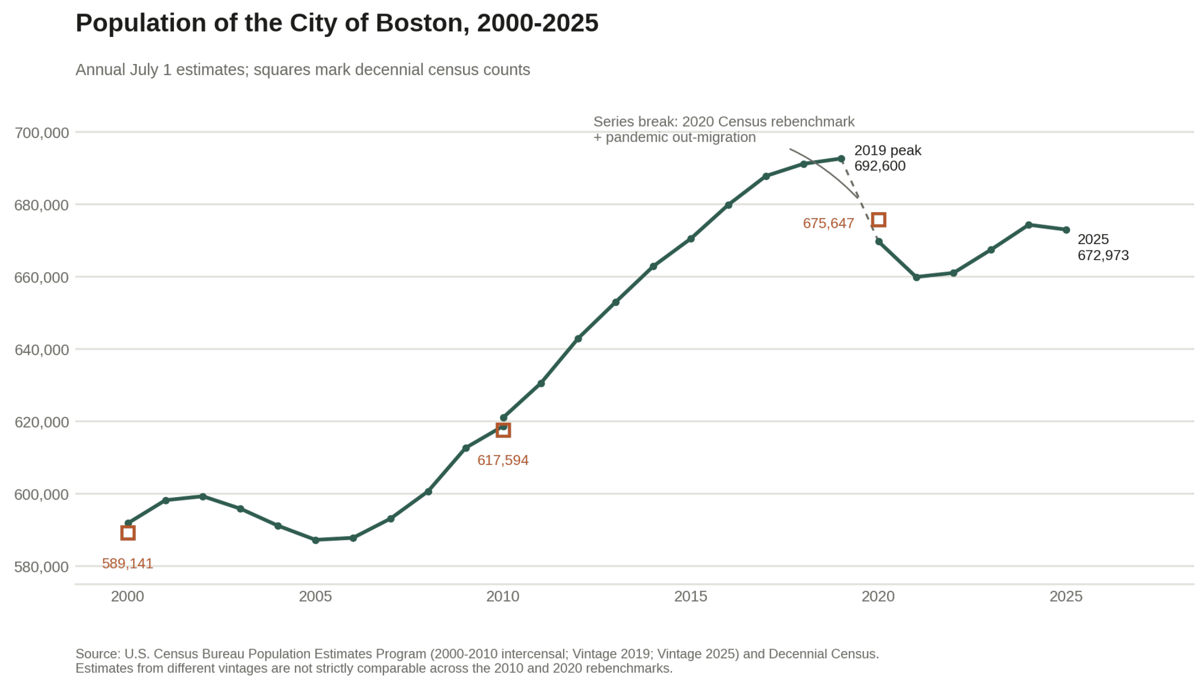
activity in existing built settings, but also on analyzing and understanding how changes in the built environment—land use and urban form changes, street redesigns, or behavioral changes—can affect pedestrian activity.

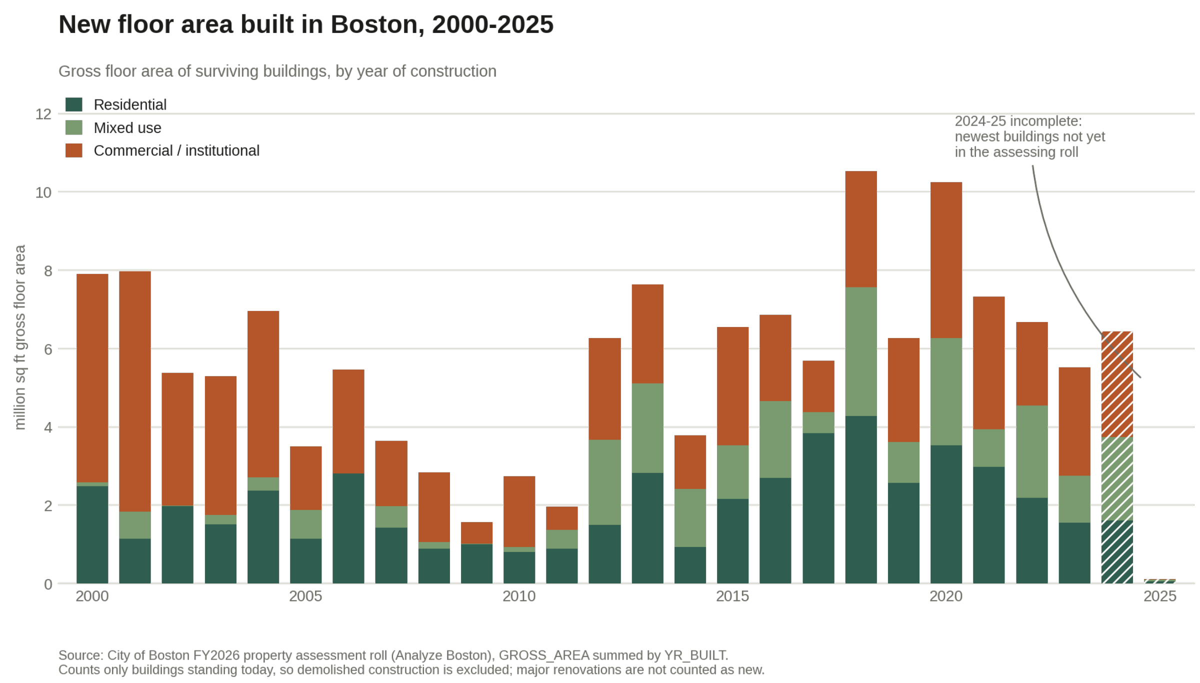
The skills built in the course will be applied in Downtown Boston. Using the Go Boston 2030 plan as a starting point, we investigate how the city's built environment – density, land use patterns, street layouts, and public transit service availability—shape existing levels of foot-traffic. Then, taking an exploratory perspective, we examine how the built environment of the city would need to transform in order to achieve a 5% increase in walking activity city-wide, as strategized by the Go Boston 2030 plan. Student teams will propose and analyze planning and design questions around pedestrian mobility in Downtown Boston, exploring how a mode shift towards a higher level of sustainable travel could be supported by built environment changes.

The course has two broad learning objectives. First, a series of individual and group exercises are meant to support conceptual understanding and technical skill building of pedestrian modeling. We will use the Urban Network Analysis framework, developed at the MIT City Form Lab to represent and analyze built environment and pedestrian interactions. The hands-on work will involve both the recent UNA Python package, and the more graphical UNA Rhinoceros 3d plugin.

Second, having developed an understanding of built environment and pedestrian interactions, we take an exploratory and speculative view and examine how changes in the built environment can improve pedestrian mode share in the city. This requires critical thinking of how certain levers of development can be adjusted to not only achieve changes that impact active mobility mode-share outcomes—by manipulating density, land use patterns, street designs, and transit services—but also how these built environment transformations can realistically be accommodated in the historic, social, economic, and political realities of the city.

Boston's population has grown from 589,141 in 2005 to 672,973 in 2025 (a 14% growth over two decades), and the city's economy has prospered largely due to the life science, IT, educational, and service industries. Both demographic and economic growth have contributed to a sizable construction boom over the last two decades, with 145 million square feet of new construction in the city during the same two and half decades. This constitutes 18.2% of the city's total gross floor area—so Boston's built environment has been changing rapidly. How and where the city's built environment grows in the next two decades will largely determine its mode share shift.





Technical skill-building in the course is structured around three phases:

- Learning about pedestrian accessibility and patronage analysis
- Learning about trip generation and route assignment to analyze pedestrian flows
- Learning about pedestrian impact assessment triggered by land use or development changes

Each phase runs for four weeks, during which you learn the spatial analysis and modeling skills, and applying them in the Boston context.

Staring mid-semester, teams of students apply the technical skills learned so far to analyze Boston. You will explore real-world planning and urban design scenarios, changing the city's built environment and synchronously analyzing the impact of changes on pedestrian trips.

Students will work with existing GIS data and maps of Boston to learn and implement ideas proposals for improving pedestrian environments around the city. Each team is asked to propose and analyze a real-world planning scenario that aims to increase the pedestrian mode share in the city. A series of presentations seek to improve and elaborate these proposals, resulting in a final proposal delivered at the end of the semester. Proposal are developed and presented in teams. A positive and constructive attitude for team-work is essential for a successful completion of the course.

There is no mid-term or final exam; assessment is based on the completion of both individual data analytic exercises, and three team-work presentations, distributing the workload throughout the semester. Class meetings introduce participants to both relevant theory and software applications needed for each experiment.

It will be useful, though not required, that participating students have taken a basic quantitative reasoning (i.e. statistics) course. Prior knowledge of Python, Rhinoceros, GIS, and Excel are helpful too, though also not strictly required. The course is very hands-on. We use multiple software platforms including Rhino, GIS, Excel, and Python along with Urban Network Analysis tools that are new and experimental.

Additionally, participants are encouraged to have completed prior course work in urban design, taken the Urban Design Skills course in DUSP (preferably both parts), or hold a prior design degree.

Learning Objectives

- Understand and be able to operationalize spatial accessibility from a pedestrian perspective.
- Use applied urban analysis techniques to understand, analyze and predict pedestrian flows in built environments.
- Explain how each of the analysis technique works in detail to stakeholders.
- Understand and explain how urban form, land uses, urban design, and public policy can affect pedestrian flows on city streets.
- Formulate analysis projects from beginning to end, presenting the findings with clarity and precision.
- Learn how to solve problems in teams (all experiments are in teams).
- Work with real-life built environments in Boston to co-develop design, planning and policy proposals.
- Learn about the place-based history of Boston's urban form.

Requirements

In order to ensure a successful completion of the class, I ask for a) your weekly presence and participation in classes, b) completion of reading materials, c) completion of individual exercises, and d) a completion and delivery of three team presentations.

Grading

Reading + discussion	20%
Individual exercises	25%
Team project development and presentations	45%
Peer evaluation by team members	10%

Ethics

Plagiarism and cheating are considered academic crimes at MIT. Never turn in an assignment that you did not write yourself, never submit an assignment for this seminar that you already submitted for another course, and never borrow or take information from another author without permission or citation. The use of Ai Models like ChatGTP and Claude are allowed in this course, so long as they are properly guided, checked, and credited by the students. Please familiarize yourselves with the university guidelines for meeting the standards of academic integrity online or ask the instructors if you have further questions.

Schedule, Readings and Deadlines:

Week 1 **Notes:**

Notes:

CLASS : 1 Thu 10-Sep-26

EXPERIMENT 1

IN CLASS:

Course Introduction , overview, logistics, distribution of class software.

Why is the study of walking important for city design, planning and policy making?

Understanding Accessibility (1). What is accessibility and what factors affect it?

Week 2 **Notes:**

CLASS : 2 Tue 15-Sep-26

EXPERIMENT 1

BEFORE CLASS:

Install UNA software for Rhino from: unatoolbox.notion.site
for python: https://canvas.mit.edu/courses/18377/files/folder/Python_UNA

a) UNA installation tutorial: https://vimeo.com/357187464

b) UNA introduction tutorial: https://vimeo.com/357187690

https://www.ted.com/talks/jeff_speck_the_walkable_city

https://www.ted.com/talks/jeff_speck_4_ways_to_make_a_city_more_walkable

IN CLASS:

Introduction to the Urban Network Analysis tools. Preparing networks, origins and destinations.

Form teams for E1 and hand out Experiment 1 brief.

ASSIGNMENT RELEASE:

Individual exericses 1A and 1B: Setting up networks and measuring access

Notes:

CLASS : 3 Thu 17-Sep-26

EXPERIMENT 1

BEFORE CLASS:

Read:

Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. Transportation Research Part D: Transport and Environment, 2(3), 199–219. https://doi.org/https://doi.org/10.1016/S1361-9209(97)00009-6

Geurs, K. T., & Wee, B. van. (2004). Accessibility evaluation of land-use and transport strategies: review and research directions. Journal of Transporation Geography, Volume 12(Issue 2), Pages 127-140.

IN CLASS:

Understanding Accessibility. What is accessibility and what factors affect it? What are different accessibility indices and their parameters. How do we use them and what do they tell us?

Week 3 **Notes:**

CLASS : 4 Tue 22-Sep-26

EXPERIMENT 1

BEFORE CLASS:

Watch and read:

Watch tutorial video on measuring access: https://vimeo.com/357187781

Watch tuorial on data import/export functions: https://vimeo.com/359358116

Yan, X. (2021). Toward Accessibility-Based Planning. Journal of the American Planning Association, 87(3), 409–423. https://doi.org/10.1080/01944363.2020.1850321

Yang, Y., & Diez-Roux, A. v. (2012). Walking Distance by Trip Purpose and Population Subgroups. American Journal of Preventive Medicine, 43(1), 11–19. https://doi.org/10.1016/j.amepre.2012.03.015

ASSIGNMENT DUE BEFORE CLASS:

Individual exericses 1A and 1B: Setting up networks and measuring access

IN CLASS:

Walk through Team E1. Accessibility modeling (Rhino). Reach, Gravity Access, Closest Facility. Using the K-nearest Neighbor (KNN) accessibility to create a composite WalkScore (release KNN Access video)

Notes:

CLASS : 5 Thu 24-Sep-26

EXPERIMENT 1

IN CLASS:

Walking tour of Downtown Boston

Week 4 **Notes:**

CLASS : 6 Tue 29-Sep-26

BEFORE CLASS:

Watch KNN Access video and try it out with your team.

Read:
WalkScore. (2011). WalkScore Methodology.
https://www.dropbox.com/scl/fi/x2t00kd6eiwy11slubjiz/WalkScore-methodology-2011_clean.pdf?rlkey=rzslaljn1vgx2feks5liccoo7&dl=0

Zafri, N., Liu, L., Sevtsuk, A. (2026). oes Pedestrian Accessibility Reflect Observed Walking Behaviour? A Sensitivity Analysis of Accessibility Parameter Choices. In review at Transportation Research Part A: Policy and Practice. Link:
https://www.dropbox.com/scl/fi/uk2h4uoexjc6ulynrcjmx/Niaz_Liu_Andres_paper.pdf?rlkey=srt2igaos1hygv90ovopq9mvp&dl=0

Iacono, M., Krizek, K., & El-Geneidy, A. (2008). Access to Destinations: How Close is Close Enough? Estimating Accurate Distance Decay Functions for Multiple Modes and Different Purposes. University of Minnesota Center for Transportation Studies. Report # 2008-11. Accessed (2/14/2021): https://www.lrrb.org/pdf/200811.pdf

IN CLASS (Lab, in 9-554):

Location allocation in GIS.

Using the K-nearest Neighbor (KNN) accessibility to create a composite WalkScore

Team consultations for Experiment 1.

ASSIGNMENT RELEASE:

Individual exercise 2: Facility location allocation in Punggol, SG

Notes:

CLASS : 7 Thu 1-Oct-26

EXPERIMENT 1

BEFORE CLASS:

Read:
Lund, H. (2003). Testing the Claims of New Urbanism: Local Access, Pedestrian Travel, and Neighboring Behaviors. Journal of the American Planning Association, 69(4), 414–429. https://doi.org/10.1080/01944360308976328

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Talen, E. (2003). Neighborhoods as Service Providers: A Methodology for Evaluating Pedestrian Access. Environment and Planning B: Planning and Design, 30(2), 181–200. https://doi.org/10.1068/b12977

Sevtsuk, A., Kalvo, R., & Ekmekci, O. (2016). Pedestrian accessibility in grid layouts: The role of block, plot and street dimensions. Urban Morphology, 20(2)

ASSIGNMENT DUE BEFORE CLASS:

Individual exercise 2: Facility location allocation in Punggol, SG

IN CLASS (Lecture, in 10-401):

How does the built environment shape accessibility outcomes?

Week 5	Notes:				Notes:		
CLASS :	8	Tue	6-Oct-26	CLASS :	9	Thu	8-Oct-26
EXPERIMENT 1				**EXPERIMENT 1**			
BEFORE CLASS:				**BEFORE CLASS:**			
				Read:			
IN CLASS (Lab, in 9-554):				Prepare E1 team presentation.			
Team consultations							
				ASSIGNMENT DUE IN CLASS (10-401):			
				Experiment 1 presentations			

Week 6	Notes:	Indigenous People's Day: Mon class on Tue.			Notes:		
NO CLASS		Tue	13-Oct-26	CLASS :	10	Thu	15-Oct-26
				EXPERIMENT 2			
				BEFORE CLASS:			
				Watch:			
				Tutorial video for Betweenness analysis: https://vimeo.com/357187941			
				Norton, P. D. (2007). Street Rivals: Jaywalking and the Invention of the Motor Age Street. Technology and Culture, 48, 331–359.			
				IN CLASS:			
				Introduction to Experiment 2			
				Individual exercise 3 (Walk routes to nearest stations in Cambridge) handed out.			
				ASSIGNMENT RELEASE:			
				Team Experiment 2			

Week 7	Notes:				Notes:		
CLASS :	11	Tue	20-Oct-26	CLASS :	12	Thu	22-Oct-26
EXPERIMENT 2				**EXPERIMENT 2**			
BEFORE CLASS:				**BEFORE CLASS:**			
Read:				Read:			
Tutorial video for Betweenness analysis: https://vimeo.com/357187941				Ewing, R., & Handy, S. (2009). Measuring the Unmeasurable: Urban Design Qualities Related to Walkability. Journal of Urban Design, 14(1), 65–84. Lue, G., & Miller, E. J. (2019). Estimating a Toronto pedestrian route choice model using smartphone GPS data. Travel Behaviour and Society, 14, 34–42. https://doi.org/https://doi.org/10.1016/j.tbs.2018.09.008 Basu, R., Sevtsuk, A., & Li, X. (2022). How do street attributes affect willingness-to-walk? City-wide pedestrian route choice analysis using big data from Boston and San Francisco. Transportation Research A, in review.			
IN CLASS:				**IN CLASS:**			
Modeling pedestrian flow with UNA.				Environmental factors affecting route choice.			
Understanding parameters.							
ASSIGNMENT RELEASE:							
Individual exercise 3: Walk routes to nearest stations in Cambridge							

Week 8	Notes:				Notes:		
CLASS :	13	Tue	27-Oct-26	CLASS :	14	Thu	29-Oct-26
EXPERIMENT 2				**EXPERIMENT 2**			
ASSIGNMENT DUE BEFORE CLASS:				**BEFORE CLASS:**			
Individual exercise 3: Walk routes to nearest stations in Cambridge				Read:			
				Sevtsuk, A., & Kalvo, R. (2018). Patronage of urban commercial clusters: A network-based extension of the Huff model for balancing location and size. Environment and Planning B: Urban Analytics and City Science, 45(3). https://doi.org/10.1177/2399808317721930 Loo, B. P. Y., Lian, T., & Frank, L. D. (2024). Walking (In)Convenience. Journal of the American Planning Association, 90(4), 742–757. https://doi.org/10.1080/01944363.2024.2310613			
IN CLASS:							
patronage Betweenness with multiple competing destinations, Huff Model, and Betweenness analysis with custom costs.				**ASSIGNMENT DUE BEFORE CLASS:**			
				Individual exercise 4: Walk routes to nearest stations in Cambridge with custom edge costs			
ASSIGNMENT RELEASE:							
Individual exercise 4: Walk routes to nearest stations in Cambridge with custom edge costs				**IN CLASS:**			
UNA Betweenness function				Straightness analysis to detect frustrating pedestrian detours.			

Week 9	Notes:				Notes:	
CLASS :	15	Tue	3-Nov-26	CLASS :	16	Thu 5-Nov-26

Tue 3-Nov-26	Thu 5-Nov-26
EXPERIMENT 2	**EXPERIMENT 2**
BEFORE CLASS:	**BEFORE CLASS:**
Read:	
	ASSIGNMENT DUE BEFORE CLASS:
IN CLASS:	Individual exercise 5: Straightness analyis
Patronage betweenness analysis for modeling pedestrian flow to competing destinations.	
Straightness analysis to detect frustrating pedestrian detours.	**IN CLASS:**
Team consultations for E2.	Team consultations for E2.
ASSIGNMENT RELEASE:	
Individual exercise 5: Straightness analyis	

Week 10	Notes:				Notes:	
CLASS :	17	Tue	10-Nov-26	CLASS :	18	Thu 12-Nov-26

Tue 10-Nov-26	Thu 12-Nov-26
EXPERIMENT 2	**EXPERIMENT 3**
BEFORE CLASS:	**BEFORE CLASS:**
Prepare E2 team presentation.	Read:
	Aoun, A., Bjornstad, J., DuBose, B., Mitman, M., & Pelon, M. (2015). Bicycle and Pedestrian Forecasting Tools: State of the Practice. Pedestrian and Bicycle Information Center White Paper Series for Federal Highway Administration DTFHGI-11-H-00024. http://www.pedbikeinfo.org/cms/downloads/PBIC_WhitePaper_Forecasting.pdf
ASSIGNMENT DUE IN CLASS (10-401):	Singleton, P. A., Totten, J. C., Orrego-Oñate, J. P., Schneider, R. J., & Clifton, K. J. (2018). Making Strides: State of the Practice of Pedestrian Forecasting in Regional Travel Models. Transportation Research Record, 2672(35), 58–68. https://doi.org/10.1177/0361198118773555
Experiment 2 presentations	
	IN CLASS:
	Introduction to Experiment 3: pedestrian impact assessment.
	E3 brief handed out.
	NOTES (instructor):
	Prepare flow analysis for downtown Boston ex ante, and distribute coefficients to students instead of having them estimate them.
	Analyze new development impacts on a) ped flows and public space improvments, b) densificatio, c) LU change, d) transit improvements.

Week 11	Notes:				Notes:	
CLASS :	19	Tue	17-Nov-26	CLASS :	20	Thu 19-Nov-26

Tue 17-Nov-26	Thu 19-Nov-26
EXPERIMENT 3	**EXPERIMENT 3**
BEFORE CLASS:	**BEFORE CLASS:**
Read:	Read:
	Gehl, J. (1987). Life between buildings : using public space. Van Nostrand Reinhold.
IN CLASS:	Anderson, S. (1993). Savannah and the Issue of Precedent: City Plan as Resource (R. Bennett (ed.); p. 290 p.). University of Delaware Press; Associated University Presses.
Understanding Elastic Weights in Betwenness Analaysis and Exploring Clustering on Networks.	(Boston Foundation 2021) 15-Minute Neighborhoods: Repairing Regional Harms and Building Vibrant Neighborhoods For All https://www.bostonindicators.org/reports/report-detail-pages/15-minute-neighborhoods
	IN CLASS:
	How the built environment shapes pedestrian flows.

Week 12	Notes:				Notes: Thanksgiving Break	
CLASS :	21	Tue	24-Nov-26	NO CLASS		Thu 26-Nov-26

Tue 24-Nov-26
EXPERIMENT 3
BEFORE CLASS:
Read:
Sevtsuk, A., Basu, R., & Chancey, B. (2021). We shape our buildings, but do they then shape us? A
IN CLASS:
Calibrating predictions on real world data.
Exmining longitudinal changes in Somerville's foot-traffic
Team consultations

Week 13	Notes:				Notes:		
CLASS :	**22**	**Tue**	**1-Dec-26**	**CLASS :**	**23**	**Thu**	**3-Dec-26**
EXPERIMENT 3				**EXPERIMENT 3**			
BEFORE CLASS:				**BEFORE CLASS:**			
SKIM:				Read:			
				Loh, T. H., Leinberger, C. B., & Chafetz, J. (2019). Foot traffic ahead. Ranking Walkable Urbanism in America's Largest Metros. https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/a/326/files/2019/06/FTA19.pdf			
IN CLASS:				ARUP. (2016). Cities Alive. Towards a Walking World.			
Comparing before/after impact scenarios.							
Team consultations				**IN CLASS:**			
				Walkability and sustainability in future cities, open to DUSP.			

Week 14	Notes:				Notes:		
CLASS :	**24**	**Tue**	**8-Dec-26**	**CLASS :**	**25**	**Thu**	**10-Dec-26**
EXPERIMENT 3				**FINAL REVIEW DATE AND TIME TBD**			
BEFORE CLASS:				**ASSIGNMENT DUE IN CLASS (10-401):**			
Read:				Finral review presentations			
IN CLASS:				**IN CLASS:**			
Team consultations				Experiment 3 final review presentations.			