

Syllabus - URP 6224 Intermediate Urban Analytics 2026 Spring

Instructor

Shenhao Wang, Ph.D. ([Google Scholar](#))
Director of [Urban AI Lab @UFL](#)
Email: shenhaowang@ufl.edu
Friday morning: 9:35am – 12:35am
Location: Arch 0439
Office hour: TBD

Course description

This course introduces the primary modeling paradigms to analyze cities with an emphasis on analytical perspectives and urban applications. The course consists of four modules with Module 1 focused on statistical analysis, Module 2 on network science, Module 3 on machine learning, and Module 4 on the final project. Specifically, Module 1 presents urban statistical analysis, mainly focused on linear regressions from the statistics tradition with applications to urban economy and mobility. Module 2 introduces the spatial visualization and regressions for urban network analysis. Module 3 discusses machine learning, including supervised learning, unsupervised learning, and deep learning with applications to mobility and socioeconomic predictions. It also discusses algorithmic fairness and analytical perspectives for computational justice in cities. The last module focuses on a research project, where students can choose their own topics and methods as hands-on practices. Students will learn Python packages, such as Pandas, GeoPandas, and Scikit-learn to analyze urban mobility, economic development, energy consumption, and housing through the in-class Python Labs. This course focuses on analytical intuition and urban applications, rather than theory or math foundations. It provides future urban planners, designers, and engineers the critical analytical capacity to understand cities and address upcoming urban challenges.

Course prerequisites

The official prerequisite courses are DCP4300/URP6931 AI in the Built Environment or URP6223 Introduction to Urban Analytics. Without satisfying the official prerequisites, students need to have prior coding experiences in Python as a prerequisite. Prior knowledge in probability, statistics, and linear algebra can also facilitate your learning experiences. If you have questions, please contact the instructor to discuss your qualification.

Coding

This course uses Python as the programming language. Students are expected to use [Google Colab](#) in the lab sessions. You don't need to install Python and other libraries on your laptop because Colab provides a standardized coding platform. The course will teach Python coding modules including [Numpy](#), [Pandas](#), [Matplotlib](#), [Statsmodels](#), [GeoPandas](#), and [Scikit-Learn](#).

Textbook

No textbook is required. The four textbooks are recommended as references for Modules 1-4.

1. VanderPlas, J. (2016). Python data science handbook: Essential tools for working with data. O'Reilly Media, Inc. GitHub link [here](#).
2. Stock, J. H., & Watson, M. W. (2011), Introduction to Econometrics, 3rd Edition.
3. Newman, M. (2018). Networks. Oxford University Press, second edition.
4. Bishop, C. M. (2006). Pattern recognition and machine learning. GitHub link [here](#).

Course schedule

Week	Dates	Lectures	Lab sessions	Reading sessions	Psets	Project
1	Jan 16	Class overview and review	Lab 01. Python Review			
Module 1: Urban statistical analysis						
2	Jan 23	Univariate linear regression	Lab 02. Property value regression part 1			
3	Jan 30	Multivariate linear regression	Lab 03. Property value regression part 2			
4	Feb 06	Logistic regression and urban application I: built environment and travel behaviors	Lab 04. Built environment and travel behavior	Y	pset 1 out	
Module 2: Urban network analysis						
5	Feb 13	Network representation, visualization, and power-law distributions	Lab 05. Network visualization			idea guideline out
6	Feb 20	Spatial autocorrelation, spatial regression, and community detection	Lab 06. Spatial analysis of property values		pset 1 due	
7	Feb 27	Urban application II: spatial analytics, and idea presentation	NA		pset 2 out	idea presentation; idea due.
Module 3: Machine learning in cities						
8	Mar 06	Supervised learning: classifications and logistic regression	Lab 08. Logistic regression in statistics and machine learning	Y		proposal guideline out
9	Mar 13	Supervised learning: regularization and diverse classifiers	Lab 09. Predicting travel demand with diverse classifiers		pset 2 due; pset 3 out	
NA	Mar 20	No class (spring break)	NA			
10	Mar 27	Proposal presentation	NA			proposal presentation; proposal due. final guideline out
11	Apr 03	Unsupervised learning, analytical fairness and urban application III: mobility predictions	NA		pset 3 due	
Module 4: Final Project						
12	Apr 10	Everything everywhere all at once: a comprehensive review		Y		
13	Apr 17	Final presentation				Final presentation; final report due

Note: This schedule is **subject to changes**.

Three Required Readings

- Week 04. Cervero, R. and K. Kockelman (1997). "Travel demand and the 3Ds: density, diversity, and design." Transportation Research Part D: Transport and Environment.
- Week 07. Hui, E. C., Chau, C. K., Pun, L., & Law, M. (2007). Measuring the neighboring and environmental effects on residential property value: Using spatial weighting matrix. Building and environment, 42(6), 2333-2343.
- Week 10. Wang, S., Mo, B., Hess, S., & Zhao, J. (2024). Comparing hundreds of machine learning and discrete choice models for travel demand modeling: an empirical benchmark. Transportation Research Part B: Methodological, 190, 103061.

Course communication

The instructor can be reached through Canvas inbox or by email. Expect a response within 48 hours, excluding holidays and weekends. General questions can be posted to the Canvas class website discussion board.

Details in Course Schedule

Practicum AI provides a wonderful overview for using Python, Colab, GitHub, and other tools in computation. It is highly recommended for the students to read the materials.

- Link to Practicum AI: <https://practicumai.org/>
- GitHub repository: <https://github.com/PracticumAI>

Review. Urban analytics and python basics

- Google Colab: Google Tutorial about Colab features
 - https://colab.research.google.com/notebooks/basic_features_overview.ipynb
- GitHub: Getting started with GitHub
 - <https://docs.github.com/en/get-started/quickstart/hello-world>
- Python basics.
 - 30-min crash course: <https://github.com/srebalaji/python-crash-course>
 - 4-hour crash course: <https://github.com/Python-Crash-Course/Python101>
 - MIT Open Course for Python Programming: <https://ocw.mit.edu/courses/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/>
- Python Pandas and Matplotlib for data description and visualization
 - Pandas and Matplotlib: Chapters 3 and 4 in VanderPlas, J. (2016) Python data science handbook: Essential tools for working with data.
 - Python tutorials: Chapters 3 and 4 in the GitHub repository: <https://github.com/jakevdp/PythonDataScienceHandbook/tree/master/notebooks>
- Data Sources.
 - American Community Survey: <https://www.census.gov/programs-surveys/acs>
 - Census Geography and TIGER Lines: <https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html>

Module 1: Urban statistical analysis

- Python statsmodels for regressions
 - Getting started: <https://www.statsmodels.org/stable/gettingstarted.html>
 - Linear regression example: <https://www.statsmodels.org/stable/regression.html>
- Readings

- (Required) Cervero, R. and K. Kockelman (1997). "Travel demand and the 3Ds: density, diversity, and design." *Transportation Research Part D: Transport and Environment*.
- (Optional) Baum-Snow & Kahn, (2000) "The effects of new public projects to expand urban rail transit." *Journal of public economics* 77(2): 241-263.
- (Optional) Glaeser, Scheinkman, & Shleifer, (1995) "Economic growth in a cross-section of cities." *Journal of monetary Economics* 36(1): 117-143.
- (Optional) Chapters 4, 6, and 9 in James Stock and Mark Watson (2011), *Introduction to Econometrics*, 3rd Edition.
- (Optional) Chapter 3 in Bishop, C. M. (2006). *Pattern recognition and machine learning*.

Module 2: Urban network analysis

- Python GeoPandas, Pysal, and NetworkX for spatial analysis.
 - GeoPandas overview: <https://geopandas.org/en/stable/index.html>
 - GeoPandas GitHub tutorial: <https://github.com/jorisvandenbossche/geopandas-tutorial>
 - Spatial visualization with GeoPandas: https://geopandas.org/en/stable/docs/user_guide/mapping.html
 - Spatial regressions with Pysal: https://sustainability-gis.readthedocs.io/en/latest/lessons/L4/spatial_regression.html
 - NetworkX: <https://networkx.org/documentation/stable/tutorial.html>
 - Spatial Data Science Python tutorials: <https://sustainability-gis.readthedocs.io/en/latest/index.html>
- Readings
 - (Required) Hui, E. C., Chau, C. K., Pun, L., & Law, M. (2007). Measuring the neighboring and environmental effects on residential property value: Using spatial weighting matrix. *Building and environment*, 42(6), 2333-2343.
 - (Optional) Chapters 3, 7 and 8 in M. Newman (2018). *Networks*. Oxford University Press, second edition.
 - (Optional) Gonzalez, M. C., Hidalgo, C. A., & Barabasi, A.-L. (2008). Understanding individual human mobility patterns. *Nature*, 453(7196), 779-782.
 - (Optional) Eagle, N., et al. (2010). "Network diversity and economic development." *science* 328(5981): 1029-1031.
 - (Optional) LeSage, J. P. and R. K. Pace (2008). "Spatial econometric modeling of origin-destination flows." *Journal of Regional Science* 48(5): 941-967.

Module 3: Machine learning in cities

- Python Scikit-learn for machine learning.
 - Scikit learn tutorial: <https://scikit-learn.org/stable/>
 - Supervised learning tutorial in Scikit-learn: https://scikit-learn.org/stable/supervised_learning.html#supervised-learning
 - Unsupervised learning tutorial in Scikit-learn: https://scikit-learn.org/stable/unsupervised_learning.html
 - GitHub tutorials for Chapters 4, 5, and 7 for Bishop, C. M. (2006): <https://github.com/gerdm/prml>
- Readings
 - (Required) Wang, S., Mo, B., Hess, S., & Zhao, J. (2021). Comparing hundreds of machine learning and discrete choice models for travel demand modeling: an empirical benchmark. *Transportation Research Part B: Methodological*, 190, 103061.
 - (Optional) Blumenstock, J., et al. (2015). "Predicting poverty and wealth from mobile phone metadata." *science* 350(6264): 1073-1076.

- (Optional) Jiang, S., Ferreira, J., & González, M. C. (2012). Clustering daily patterns of human activities in the city. *Data Mining and Knowledge Discovery*, 25(3), 478-510.
- Karlaftis, M. G., & Vlahogianni, E. I. (2011). Statistical methods versus neural networks in transportation research: Differences, similarities and some insights. *Transportation research part C: emerging technologies*, 19(3), 387-399.
- (Optional) Hardt, M., Price, E., & Srebro, N. (2016). Equality of opportunity in supervised learning. *Advances in Neural Information Processing Systems*, 29, 3315-3323.
- (Optional) Chapters 4, 5, and 7 in Bishop, C. M. (2006). *Pattern recognition and machine learning*.

Grading

Your grade consists of the follow three components.

Components	Total points	Percentage of final grade
Course participation	100	10%
Problem sets (3)	100 each	45%
Project	100	45%

Course participation (10 pts)

Attendance and participation in the class are required. Attendance and participation grade will be computed in proportion to the number of presences. Students are also highly encouraged to get engaged in the class discussions. The university policy can be found [here](#).

Problem sets (45 pts)

Problem sets are designed to help you learn how to apply the analytical tools to cities. Students are allowed to work in groups, as long as each group is comprised of no more than three people and each member submits their own written answers.

1. Pset 1 (15 pts) – Urban statistical analysis.
2. Pset 2 (15 pts) – Urban network analysis.
3. Pset 3 (15 pts) – Machine learning in cities.

Project: three stages (45 pts)

1. Idea (5 pt). Limit to 1 page.
2. Proposal (10 pt). Limit to 3 pages.
3. Final paper (30 pt). Limit to 8 pages.

Grading scale

The following table is used as **an example only**.

	Percent Grade	4.0 Scale		Percent Grade	4.0 Scale
A	94-100	4.0	C	73-76	2.0
A-	90-93	3.67	C-	70-72	1.67
B+	87-89	3.33	D+	67-69	1.33
B	83-86	3.0	D	65-66	1.0
B-	80-82	2.67	E/F	Below 65	0.0
C+	77-79	2.33			

The grading follows the university policy [here](#).

Late Submission

It is important to meet deadlines. All work must be completed and submitted by the designated date and time on Canvas. However, life is sometimes uncertain. Therefore, you are allowed to submit your

assignments late, but with **3 points deducted for every 24 hours**. For example, if an assignment is submitted 1 hour after the deadline, its full grade will automatically drop from 15 points to 12 points. This policy applies to both Psets and the milestones of the project.

Other UF policies and resources

Accommodating Students with Disabilities

Students requesting accommodation for disabilities must first register with the Dean of Students Office (<https://disability.ufl.edu/>). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive, therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

Academic integrity and UF honor code

Academic honesty and integrity are fundamental values of the University community. UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Course evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available [here](#). Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via this [link](#). Summaries of course evaluation results are available [here](#).

Other academic resources

- For On-Campus URP Students: Graduate Coordinator contact information: Laura Dedenbach, laurajd@ufl.edu, 352-294-1493.
- Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services career.ufl.edu/.
- Library Support: various ways to receive assistance with respect to using the libraries or finding resources. cms.uflib.ufl.edu/ask
- Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring. teachingcenter.ufl.edu/
- Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. writing.ufl.edu/writing-studio/
- For issues with technical difficulties for E-learning in Canvas, please contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu
- Student Complaints: sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

Health and wellness

- U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit umatter.ufl.edu/ to refer or report a concern and a team member will reach out to the student in distress.
- Counseling and Wellness Center: Visit counseling.ufl.edu/ or call 352-392-1575 for information on crisis services as well as non-crisis services.
- Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need or visit shcc.ufl.edu/.
- University Police Department: Visit police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).
- UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; ufhealth.org/emergency-room-trauma-center