Syllabus - URP 6224 Intermediate Urban Analytics
2024 Spring

Instructor
Shenhao Wang, Ph.D. (Google Scholar)
Director of Urban AI Lab @UFL
Email: shenhaowang@ufl.edu
Thursday morning: 8:30am – 11:30am
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 five modules with Module 1 focused on urban analytical basics, Modules 2-4 on statistical analysis, network science, and machine learning, and Module 5 on the final project. Specifically, Module 1 introduces Python syntax, urban data sources, static data description, and other urban analytical basics. Module 2 presents urban statistical analysis, mainly focused on linear regressions from the statistics tradition with applications to urban economy and mobility. Module 3 introduces the spatial visualization and regressions for urban network analysis. Module 4 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. 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
No strict prerequisite course is needed. However, students have prior coding experiences in Python or need to take Practicum AI at UFL as a concurrent requirement. 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.
# Course schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Lectures</th>
<th>Lab sessions</th>
<th>Work sessions</th>
<th>Psets</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 11</td>
<td>Class overview</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Module 1: Urban analytical basics**

| 2 | Jan 18 | Urban data sources and Python basics | Lab 02. Python in Colab and GitHub basics |  |  |  |
| 3 | Jan 25 | Data description and visualization | Lab 03. ACS and spatial data |  |  |  |
| 4 | Feb 1  | Correlational analysis and urban application | Lab 04. Gasoline consumption and cities |  | pset 1 out |  |

**Module 2: Urban statistical analysis**

| 5 | Feb 8  | Univariate linear regression | Lab 05. Car ownership regression part 1 |  |  | idea guideline out |
| 6 | Feb 15 | Multivariate linear regression | Lab 06. Car ownership regression part 2 |  | pset 1 due |  |
| 7 | Feb 22 | Urban application in linear regressions: built environment and travel behaviors | Lab 07. Built environment and travel behavior |  | pset 2 out | idea due |

**Module 3: Urban network analysis**

| 8 | Feb 29 | Network representation and spatial visualization | Lab 08. Visualizing property values |  |  |  |
| 9 | Mar 7  | Spatial autocorrelation and regression for property values | Lab 09. Spatial analysis of property values |  | pset 2 due | pset 3 out proposal guideline out |
| NA | Mar 14 | No class (spring break) | NA |  |  |  |
| 10 | Mar 21 | Review, mid-term survey, and proposal presentation | NA |  |  | proposal presentation; proposal due |

**Module 4: Machine learning in cities**

| 11 | Mar 28 | Supervised learning: classifications and logistic regression | Lab 11. Predicting sustainable travel behavior part 1 |  | pset 3 due | pset 4 out |
| 12 | Apr 4  | Supervised learning: diverse classifiers for mobility predictions | Lab 12. Predicting sustainable travel behavior part 2 |  |  |  |
| 13 | Apr 11 | Unsupervised learning and analytical fairness | Lab 13: Clustering to redefine spatial boundaries | Y |  | pset 4 due |

**Module 5: Final Project**

| 14 | Apr 18 | Work session | NA | Y |  |  |
| 15 | Apr 25 | Final presentation | NA |  | final presentation; final report due |  |

Note: This schedule is subject to changes.
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

Module 1. Urban analytical basics
- Google Colab: Google Tutorial about Colab features
  o https://colab.research.google.com/notebooks/basic_features_overview.ipynb
- GitHub: Getting started with GitHub
  o https://docs.githubusercontent.com/en/get-started/quickstart/hello-world
- Python basics.
  o 30-min crash course: https://github.com/srebalaji/python-crash-course
  o 4-hour crash course: https://github.com/Python-Crash-Course/Python101
  o 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
  o Python tutorials: Chapters 3 and 4 in the GitHub repository: https://github.com/jakevdp/PythonDataScienceHandbook/tree/master/notebooks
- Data Sources.
  o American Community Survey: https://www.census.gov/programs-surveys/acs
  o Census Geography and TIGER Lines: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html
- Readings

Module 2: Urban statistical analysis
- Python statsmodels for regressions
  o Getting started: https://www.statsmodels.org/stable/gettingstarted.html
  o Linear regression example: https://www.statsmodels.org/stable/regression.html
- Readings
  o (Optional) Chapters 4, 6, and 9 in James Stock and Mark Watson (2011), Introduction to Econometrics, 3rd Edition.
Module 3: Urban network analysis

- Python GeoPandas, Pysal, and NetworkX for spatial analysis.
  - GeoPandas GitHub tutorial: https://github.com/jorisvandenbossche/geopandas-tutorial
  - Spatial visualization with GeoPandas:
  - Spatial regressions with Pysal:
  - Spatial Data Science Python tutorials:

- Readings

Module 4: Machine learning in cities

- Python Scikit-learn for machine learning.
  - Scikit learn tutorial: https://scikit-learn.org/stable/
  - Supervised learning tutorial in Scikit-learn:
  - Unsupervised learning tutorial in Scikit-learn:
  - GitHub tutorials for Chapters 4, 5, and 7 for Bishop, C. M. (2006):
    https://github.com/gerdm/prml

- Readings
Grading

Your grade consists of the follow three components.

<table>
<thead>
<tr>
<th>Components</th>
<th>Total points</th>
<th>Percentage of final grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course participation</td>
<td>100</td>
<td>10%</td>
</tr>
<tr>
<td>Problem sets (4)</td>
<td>100 each</td>
<td>40%</td>
</tr>
<tr>
<td>Project</td>
<td>100</td>
<td>50%</td>
</tr>
</tbody>
</table>

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 (40 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 (10 pts) – Urban analytical basics.

Project: three stages (50 pts)
1. Idea (5 pt). Limit to 1 page.

Grading scale
The following table is used as an example only.

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

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 **2 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 10 points to 8 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