

Transportation Data Analytics

CGN 4905/6905

Class Periods: Tuesday & Thursday, Period 9-10, and 4:05pm-5:35pm

Location: MAEB 0238

Academic Term: Fall 2022

Instructor:

Dr. Xilei Zhao

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Office: Weil Hall 504

Office Hours: 11am-12pm on Tuesday

Course Description

This course is designed for training the next-generation Transportation Engineers who can leverage state-of-the-art techniques and tools in data science and apply them to solve Transportation Engineering problems. This course covers fundamentals of data analytics and focuses on how to use these methods for transportation applications, especially related to Intelligent Transportation Systems (ITS). The students will gain essential knowledge and programming skills (using R) in analyzing intermodal freight transportation data, public transit data, crash data, and GPS data. Some advanced topics, such as machine learning applications in transportation and security and data privacy of modern automobiles, will be introduced by the end of the course. The course will be divided into one lecture and one computer lab per week, so that the students will gain hands-on experience with transportation data analytics. This course has 3 credit hours.

This is a registered in-person class that will be taught primarily in the face-to-face mode in room (MAEB 0238) at the scheduled times (Period 9-10). The class may be recorded via Zoom in order to anticipate and accommodate any student seeking remote access. Recordings will be made available through Canvas shortly after the live class.

Course Pre-Requisites / Co-Requisites

Undergraduate level courses in probability and statistics

Course Objectives

After taking this course, the students will be able to:

- Understand the characteristics of ITS
- Grasp fundamentals of data analytics for ITS
- Apply data analytics to tackle real-world problems in typical transportation applications
- Implement data analytics techniques and tools in R
- Interpret data analytics results to gain insights for decision making

Materials and Supply Fees

Slides, handouts, papers, etc. No fees.

Professional Component (ABET):

Students will learn essential skills from the course to meet the professional components of the ABET-accredited Civil Engineering degree.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with	Medium

consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	High
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	High
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	High
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	High
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

- R and RStudio

Recommended Materials

- **Data Analytics for Intelligent Transportation Systems**
- Mashrur Chowdhury, Amy Apon, Kakan Dey
- April 18, 2017
- ISBN: 978-0-12-809715-1

- **Big Data Analytics for Connected Vehicles and Smart Cities**
- Bob McQueen
- April 18, 2017
- ISBN 13: 978-1-63081-321-5

Course Schedule

- Week 1: **Lecture 1:** Intelligent Transportation Systems (ITS) and its relationship with data analytics
Computer Lab 1: Introduction to R programming: Part I
- Week 2: **Lecture 2:** Data lifecycle, data pipelines, and data infrastructure for ITS
Computer Lab 2: Introduction to R programming: Part II
- Week 3: **Lecture 3:** Data infrastructure for ITS
Computer Lab 3: Introduction to R programming: Part III, [Quiz 1](#)
- Week 4: **Lecture 4:** Fundamentals of data analytics for ITS: Part I
Computer Lab 4: Data collection and processing
- Week 5: **Lecture 5:** Fundamentals of data analytics for ITS: Part II
Computer Lab 5: Interactive data visualization
- Week 6: **Lecture 6:** Data analytics for intermodal freight transportation applications: Part I
Computer Lab 6: Descriptive data analytics for freight transportation, [Quiz 2](#)
- Week 7: **Lecture 7:** Data analytics for intermodal freight transportation applications: Part II

Computer Lab 7: Predictive data analytics for freight transportation

- Week 8: **Lecture 8:** Data analytics for public transit applications: Part I
Computer Lab 8: Transit data collection and processing
- Week 9: **Lecture 9:** Data analytics for public transit applications: Part II
Computer Lab 9: Transit origin-destination demand estimation
- Week 10: **Lecture 10:** Midterm exam
Computer Lab 10: Transit trip purpose inference
- Week 11: **Lecture 11:** Data analytics for safety applications: Part I
Computer Lab 11: Crash count/frequency modeling
- Week 12: **Lecture 12:** Data analytics for safety applications: Part II
Computer Lab 12: Crash injury severity modeling
- Week 13: **Lecture 13:** Social media data in transportation
Computer Lab 13: Introduction to Twitter mining
- Week 14: **Lecture 14:** Machine learning in transportation data analytics
Computer Lab 14: A decision tree application in travel mode choice modeling
- Week 15: **Lecture 15:** Security and data privacy of modern automobiles
Computer Lab 15: Preparation for term project

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by

a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Attendance Policy, Class Expectations, and Make-Up Policy

Students are expected to attend all the lectures and labs either in person or virtually. Students are also advised to bring their personal computers to the labs. Please come to class prepared to ask and answer questions and actively participate in group discussions. All the homework assignments will be based on the content covered in class and/or reading materials. Collaborating with others is fine as long as you finish and turn in your own assignment. **Copying of other's work is plagiarism and will not be allowed.** Homework assignments must be turned in at the beginning of the class on the due date. Late submissions will not be accepted, except under special circumstances or when prior permission has been sought.

There will be two quizzes and one midterm exam. The quizzes and midterm exam will be open-book. Requests for make-up quizzes and exam are strongly discouraged. Such requests will be accommodated only under special circumstances and when prior permission from the instructor has been sought adequately in advance.

Term project will be conducted by team of 2~3 people. A term project report must be submitted by the due date. Late submissions will not be accepted, except under special circumstances or when prior permission has been sought. In the report, all the information extracted from external references must be cited. **An author contribution statement** must be included in the end of the report, by specifying the contributions of each team member in terms of study conception and design, data collection, modeling and software development, analysis and interpretation of results, and report preparation. The term project will be presented in class during the final exam period. Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (6)	100 each	30%
Quizzes (2)	100 each	10%
Midterm Exam	100	20%
Term Project	100	30%
Class Participation	100	10%
		100%

Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

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 at <https://gatorevals.aa.ufl.edu/students/>. 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 <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

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." The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. 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.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.