ENVIRON 790.02 Water Data Analytics
Spring Semester 2022

Meeting times: Tuesdays 7:00-8:15 pm
Classroom: Grainger Hall 1104
Course resources: sakai.duke.edu

Professor: Kateri Salk
Pronouns: she/her
Email: kateri.salk@duke.edu
Office hours: to be announced (held online)

Course Texts and Resources
This course will not require any advance purchases of textbooks or other resources. Required resources will consist primarily of scholarly articles and online databases, all of which will be provided on Sakai and/or GitHub. Students will be expected to have installations of R, RStudio, and LaTeX installed on their computers (see Software Installation Guide).

Course Description
Focus on development of quantitative approaches used to interpret data in the fields of hydrology and limnology, with application to case studies in water science. In this course, we will (1) generate knowledge of fundamental processes in aquatic ecosystems as they relate to applied settings, (2) develop and apply data science skills to datasets in the water resources field. Prerequisites: Landscape Hydrology (EOS 723) (or other hydrology or limnology course), and prior experience with computational software (R preferred; Stata, Python, MATLAB, and/or GIS acceptable).

Course Objectives
As part of their active participation and completion of the course, students will:

1. Synthesize information on fundamental and applied topics in water resources using quantitative analysis
2. Apply the appropriate steps of the data analytics pipeline to answer questions about aquatic systems
3. Develop marketable skills in data management, analysis, and communication for the aquatic sciences field

Expectations
My approach to teaching is to act as a facilitator in a learner-centered environment. While I have significant expertise in the topics presented in this course, my goal is to set up class sessions and assignments that push you to develop this expertise for yourselves. As a consequence, it is crucial for each of you to come to class each day ready to participate, take intellectual risks, and cooperate with each other. I will do my best to create a classroom environment in which you feel comfortable doing so.

COVID Policy
Student health, safety, and well-being are the university's top priorities. To help ensure your well-being and the well-being of those around you, **please do not come to class** if you have symptoms related to COVID-19, have had a known exposure to COVID-19, or have tested positive for COVID-19. If any of these situations apply to you, you must follow university guidance related to the ongoing COVID-19 pandemic and current health and safety protocols. If you are experiencing any COVID-19 symptoms, contact student health. 919-681-9355.

Grading
Grading scale

A	93-100
A-	90-92
B+	87-89
B	83-86
B-	90-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	Below 60

Assignments for guided sessions (80% of final grade)
Each major unit of the course will be associated with an assignment that includes a discussion of a concept in aquatic science, analysis in R, and evaluation of findings from a real-world dataset.

Course project (20% of final grade)
Each student will choose a question pertaining to aquatic science or water resources and perform a quantitative analysis to answer this question. The project will be broken into several stages, including:

- Initial idea (2%)
- Workshop session (5%)
- Final report (10%)
- Final presentation (3%)

Schedule

Date	Topic	Due
Week 1 January 11	Introduction • Big data in aquatic science • R boot camp • Fundamentals of visualization *Packages: tidyverse, lubridate*	Completion of software installation Office hours survey
Week 2 January 18	Physical properties of lakes • Stratification • Climate change *Packages: cowplot*	Assignment 1: Intro and visualization example

Week 3 January 25	Physical properties of rivers • Seasonal discharge patterns • Stormflow hydrographs • Baseflow separation • Low flow: 7Q10 • Channelization and dams *Packages: dataRetrieval*	Assignment 2: Physical properties of lakes
Week 4 February 1	Physical properties of rivers cont'd	Assignment 3: Physical properties of rivers
Week 5 February 8	Water quality in lakes • Nutrients • Chlorophyll • Oxygen • Trophic status, eutrophication • Stressor-Response analysis *Packages: LAGOSNE, rLakeAnalyzer, Water Quality Portal Discovery Tool*	Assignment 4: Physical properties of rivers
Week 6 February 15	Water quality in lakes cont'd	Assignment 5: Water quality in lakes
Week 7 February 22	Water quality in rivers • Microbiological indicators • Salinization	Assignment 6: Water quality in lakes
Week 8 March 1	Time series analysis • Long-term datasets • Gaps and autocorrelation • Interpolation *Packages: trend, forecast, tseries*	Assignment 7: Water quality in rivers
SPRING BREAK March 5-13		
Week 9 March 15	Time series analysis cont'd	
Week 10 March 22	Spatial analysis in lakes *Packages: sf, maps, randomForest*	Assignment 8: Time series
Week 11 March 29	Spatial analysis in rivers *Packages: riverdist, nhdplusTools, streamstats*	Assignment 9: Spatial analysis in lakes
Week 12 April 5	High frequency data *Packages: EcoHydRology*	Assignment 10: Spatial analysis in rivers
Week 13 April 12	Final project workshopping	Bring to class a challenge related to your project (e.g., idea formulation, coding road block, interpretation)
Final Exam Tuesday, April 26 7:00 pm	Final project presentations	Final project report

Details of this syllabus, including but not limited to grading and schedule, are subject to change at the instructor's discretion. Students will be notified of any changes in advance and in writing.

The Duke Community Standard
All students must adhere to the Duke Community Standard (DCS): Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, and accountability. Citizens of this community commit to reflect upon these principles in all academic and non-academic endeavors, and to protect and promote a culture of integrity.

To uphold the Duke Community Standard:
Students affirm their commitment to uphold the values of the Duke University community by signing a pledge that states:

- I will not lie, cheat, or steal in my academic endeavors;
- I will conduct myself honorably in all my endeavors;
- I will act if the Standard is compromised

Regardless of course delivery format, it is the responsibility of all students to understand and follow Duke policies regarding academic integrity, including doing one's own work, following proper citation of sources, and adhering to guidance around group work projects. Ignoring these requirements is a violation of the Duke Community Standard. If you have any questions about how to follow these requirements, please contact Jeanna McCullers, Director of the Office of Student Conduct.

If a student engages in academic dishonesty (e.g., cheating, plagiarism), they will receive an automatic zero on that assignment. Additional incidences of academic dishonesty will result in automatic failure of the course. I will also report incidences of academic dishonesty to the Office of Student Conduct, who may choose to impose additional consequences.

Accommodations
Students with disabilities seeking special accommodations must contact Emma H. Swain (eswain@duke.edu, 668-1267) at the Student Disability Access Office (SDAO) to obtain appropriate support. See also http://www.access.duke.edu/

There are several official channels on campus that allow accommodations for situations including disabilities, illness, and bereavement. However, I understand that many students cope with challenges throughout the semester that fall outside these official channels. If you are in a situation that prevents you from actively engaging in the course and completing coursework, please come to me and we can discuss alternate arrangements.

Campus Resources for Students
Your mental and physical wellbeing is integral to your ability to be academically successful. Below, I have compiled a list of resources around campus that are available to support you. In addition, please feel free to contact me anytime if you are struggling or would like help finding support resources on campus.

Student mental health and wellness is of primary importance at Duke, and the university offers resources to support students in managing daily stress and self-care. Duke offers several resources for students to seek assistance on coursework and to nurture daily habits that support overall well-being, some of which are listed below

- **The Academic Resource Center**: (919) 684-5917, theARC@duke.edu, or arc.duke.edu,
- **DuWell**: (919) 681-8421, provides Moments of Mindfulness (stress management and resilience building) and Koru (meditation) programming to assist students in developing a daily emotional well-being practice. To see schedules for programs please see https://studentaffairs.duke.edu/duwell. All are welcome and no experience necessary. duwell@studentaffairs.duke.edu, or https://studentaffairs.duke.edu/duwell

If your mental health concerns and/or stressful events negatively affect your daily emotional state, academic performance, or ability to participate in your daily activities, many resources are available to help you through difficult times. Duke encourages all students to access these resources.

- **DukeReach.** Provides comprehensive outreach services to identify and support students in managing all aspects of well-being. If you have concerns about a student's behavior or health visit the website for resources and assistance. http://studentaffairs.duke.edu/dukereach
- **Counseling and Psychological Services (CAPS).** CAPS services include individual, group, and couples counseling services, health coaching, psychiatric services, and workshops and discussions. CAPS also provides referral to off-campus resources for specialized care. (919) 660-1000. https://studentaffairs.duke.edu/caps
- **Blue Devils Care.** A convenient, confidential, and free way for Duke students to receive 24/7 mental health support through TalkNow and scheduled counseling. bluedevilscare.duke.edu

Academic Resource Center
The Academic Resource Center (the ARC) offers services to support students academically during their undergraduate careers at Duke. The ARC can provide support with time management, academic skills and strategies, unique learning styles, peer tutoring, learning consultations, learning communities, and more. ARC services are available free to any Duke undergraduate student, in any year, studying in any discipline.

(919) 684-5917, theARC@duke.edu, or arc.duke.edu

Graduate Career Services
Duke Career Center
Sexual Assault Resources
If you have experienced sexual assault, sexual harassment, gender violence, relationship violence, or stalking, please reach out for help. There are several resources around campus to support you:
The Women's Center: 919-684-3897. Services are available to all genders, not just women.
Office of Student Conduct: 919-684-6938
Duke Police: 919-684-2444

My door is always open if a student needs someone to listen or to connect them with resources. As an employee of Duke, I am a mandatory reporter, meaning that if I receive a report of sexual

assault, I am required to confidentially report this to the Office of Student Conduct (OSC). The OSC will follow up with the student to provide further information, but the student is not required to respond, and the conversation will not be shared beyond myself and the OSC. The following resources around campus are not mandatory reporters: The Women's Center, medical providers, campus clergy, and CAPS counselors.

Recreation and Exercise Opportunities
Duke Recreation Website: Information about exercise facilities, intramural sports, and fitness services

Al Buehler Trail: A hiking and running trail south of Duke's west campus, free for use. The main trail is 3 miles long with beautiful scenery, and a separate 0.58 mile "fitness loop" includes bodyweight training stop points for a guided workout. Emergency phones are placed at 7 locations along the trail.

Duke Gardens: Free admission and inexpensive parking. Located on the east side of Duke's west campus.

Food Insecurity
As part of our community care, we have a food exchange available for students, faculty and staff who find themselves on campus without the means to eat. The Nicholas School understands there may be times when financial situations may make it difficult to provide a meal for yourself and we want to make sure we can help minimize these situations. As such, the first floor kitchen in Grainger Hall and the second floor kitchen in LSRC have been stocked with non-perishable single-serve food items that you are invited to take if you need it.