University of Florida
Soil, Water, and Ecosystem Sciences Department
Fall 2025

Soil Health and Data

SWS 6406

Instructor:

Dr. Yang Lin
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University of Florida – Gainesville
Email: ylin2@ufl.edu
Office hours: Tuesdays 12:30 to 1:30 pm

Course credits: 3

Teaching Format and Course Communications:

- Exclusively online.
- Pre-recorded lectures, weekly data tutorials and assignments, weekly chat sessions, group projects, assignments, and exams.
- Canvas eLearning Login: http://elearning.ufl.edu/
- Contact instructor through Canvas messaging system or email.
    - Allow 24 hours for a response during the week.
    - Questions posted over the weekend will not receive a response until Monday.

Pre-Requisites: N/A

Required Textbook: None

- Required readings are available on Canvas. Students will discuss the following papers in the journal club:
    - Amsili, J.P., van Es, H.M. and Schindelbeck, R.R. Soil Security 4, 100012 (2021).
    - Bagnall, D.K., et al. Agronomy Journal *113*, 4581-4589 (2021).
    - Culman, S. W. et al. Soil Sci Soc Am J 76, 494–504 (2012).
    - Fine, A. K., Es, H. M. & Schindelbeck, R. R. Soil Sci Soc Am J 81, 589–601 (2017).
    - Lehmann, J. et al. Nat Rev Earth Environ 1–10 (2020)
    - Liptzin, D. et al. Soil Biology Biochem 172, 108708 (2022).
    - Nunes, M.R., Karlen, D.L. and Moorman, T.B. Sustainability *12*, 2071 (2020).
    - Stewart, R. D. et al. Agricultural & Environmental Letters 3 (2018).
    - Sanderman, J., Hengl, T. & Fiske, G. J. Proc National Acad Sci 114 (2017).
    - Wittwer, R.A., et al. Science Advances 7, eabg6995 (2021).

Course Description (50 words limit for catalog): Examine the concept, history, and underlying science of soil health; Apply basic statistical methods to analyze soil data and

assess soil health in the R programming environment; Compare and select soil health indicators; Discuss the management practices for enhancing soil health.

Course Details: Soil health has emerged as a unifying concept with broad endorsement from the agriculture enterprise to sustain and promote long-term sustainability of soil sources. How to translate soil data into actionable management practices and policy recommendations remains a key challenge. This course couples the underlying science behind the concept of soil health with the analytical methods of soil data. In the lectures, we will study the fundamentals of soil health and introduce the general framework of soil health assessment. Using hands-on data tutorials, students will learn how to interact with soil health data including data structure, data management, and programming for data analysis and visualization. No prior experience in R programming is needed, as the tutorials will be self-guided to provide the necessary knowledge on these topics. Students' learning will be supported via peer discussion over Canvas, weekly chat sessions, and appointments with the instructor.

Course Learning Objectives:

After successfully completing the course, students will be able to:

- Define and critique the concept of soil health
- Compare and select soil health indicators for field evaluation
- Develop basic programming proficiency in R
- Apply statistical methods to describe, visualize, and interpret soil health data
- Identify common management practices for enhancing soil health and evaluate their potentials and limitations
- Assess the unique challenges in quantifying and managing soil health in the state of Florida

Tentative Course Schedule:

Week	Lecture topics	Data tutorials	Journal club	Assignment/Project
8/21	Introduction			
8/25	Definition of soil health	Introduction to R and Rstudio	Lehmann et al. 2020	Assignment 1 due 8/31
9/2	History of soil health	Data tables in R	Bagnall et al. 2021	Assignment 2 due 9/7
9/8	Trajectories of soil health: degradation vs restoration	Descriptive statistics with `dplyr` package	Sanderman et al. 2017	Assignment 3 due 9/14
9/15	Physical indicators	Plotting data with `ggplot2` package	Nunes et al. 2020	Assignment 4 due 9/21
9/22	Chemical indicators	ANOVA in soil health	Stewart et al. 2018	Assignment 5 due 9/28
9/29	Biological indicators	Regression in soil health	Culman et al. 2012	Assignment 6 due 10/5
10/6	Exam 1			

10/13	Introduction to soil health assessment	Scoring functions	Fine et al. 2017	Assignment 7 and Proposal due 10/19
10/20	Scoring functions	Minimal dataset for soil health assessment	Amsili et al. 2021	Assignment 8 due 10/26
10/27	Weighing functions and integration	Factor analysis	Chahal and Eerd 2019	Assignment 9 due 11/2
11/3	Soil health management	Case studies	Liptzin et al. 2022	Assignment 10 due 11/9
11/10	Soil health in Florida	Meta-analysis	Wade et al. 2022	Assignment 11 due 11/16
11/17	Review			Paper due 11/23
12/1	Exam 2			Group presentation

Data Tutorials: They are hands-on, self-paced guides to complete data wrangling, analysis, and visualization using R. Each tutorial will include several learning objectives to develop students' skills in programming, data analytics and applying these skills to solve soil health questions. Each tutorial will be accompanied with a video walk-through posted on Canvas.

Assignments: Assignments are designed based on each week's data tutorial. They include case-based questions reflecting the learning objectives of data tutorials. They are completed on Posit.Cloud. Instruments for setting up Posit.Cloud are provided on Canvas. Assignments are due on Saturday 11:59 pm (Eastern time) weekly.

Deadlines for assignments are carefully structured to support your learning journey by ensuring a consistent and manageable pace throughout the course. Meeting these deadlines allows you to engage with the material in alignment with the class schedule and to benefit fully from subsequent lessons. To provide flexibility, late submissions will be accepted until the final deadline of **December 6th**. Please note that delayed submissions may disrupt the intended learning progression and could negatively impact your ability to keep up with the course. To make the most of this course, **I strongly encourage you to submit your work on time whenever possible.**

Exams: They will include two types of questions: 1) case-based questions that are based on data tutorials and assignments and 2) short-answer questions on the science, assessment, and management of soil health. They are open-book but not open-peers. They will be submitted on Canvas.

Chat Sessions: Weekly chat sessions will be scheduled after a doodle pool where students indicate their availabilities. All students are expected to participate. Zoom link can be found on the course's home page. Students will need access to a computer with audio and a web camera (optional) to take this course. If you are unable to attend a chat session, chat

sessions may be replaced with chat make-up assignments on Canvas at the instructors' discretion.

Journal Club: Each week, students will discuss a paper during *the 2nd half of the chat session*. The goal here is to critically evaluate some of the current literature on soil health. Students will take turns to lead the discussion. The discussion leader will provide a short summary of the paper (< 3 minutes) and develop a list of questions for discussion. The instructor will randomly assign the discussion leaders. Attendance is required as a part of the grade for participation (See grading structure). Further tips will be posted on Canvas.

Course Project: Students are required to work individually for a course research project. Each student will collect data from literature and/or existing databases and conduct a research project on the topic of soil health. Students may NOT use data from their own research projects, since the course project is designed to explore the availability of data in soil health research. They may repeat analyses that have been published, conduct a meta-analysis, or ask new questions. Students will communicate their research in the form of a short research paper and a presentation and work on their skills in scientific reasoning and hypothesis testing. The project will include three components, a proposal, a paper, and a presentation, which account for 20%, 40%, and 40% of the grade, respectively. More guidelines will be provided on Canvas.

Critical Dates: Assignments are due on Saturday 11:59 pm (Eastern time) weekly. Open-book exams will be held for three days in the weeks of Oct. 6 and Dec. 1. Additional details on the exam will be provided on Canvas.

Group project:

- Proposal due: 10/18
- Paper and presentations due: 12/3

Disclaimer: As we go through the semester, specific topics and activities on the syllabus may change to enhance the class learning opportunity. Such changes will be communicated clearly and in advance.

Material and Supplies Fee: N/A

Grading Structure

Assessment Type	Percent of Final Grade
Exams (2 total)	30
Weekly Assignments (10 total)	40
Group projects	20
Participation (chat and journal club)	10

Rubrics will be provided with graded activities. See Canvas assignments for individual rubrics. Exams are open book.

Grading Scale

A	90-100	B+	87-89.99	B	80-86.99	C+	77-79.99
C	70-76.99	D+	67-69.99	D	60-66.99	E	<60

For information on current UF policies for assigning grade points, see https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/.

Attendance and Late Policy: Make-up exams are provided only under extreme, documented circumstances. Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/.

Privacy Disclaimer: Our discussion or 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.

ACADEMIC POLICIES:

- Requirements for class attendance and make-up exams, assignments, and other work in the course are consistent with university policies. See UF Academic Regulations and Policies for more information regarding the University Attendance Policies.

- Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the Disability Resource Center. See the "Get Started With the DRC" webpage on the Disability Resource Center site. 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.

- Information on current UF grading policies for assigning grade points. This may be achieved by including a link to the University grades and grading policies.

- Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online. Students can complete evaluations in three ways:
    1. The email they receive from GatorEvals
    2. Their Canvas course menu under GatorEvals
    3. The central portal at https://my-ufl.bluera.com

Guidance on how to provide constructive feedback is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

- The University's Honesty Policy regarding cheating, plagiarism, etc.:

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 Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. See the UF Conduct Code website for more information. If you have any questions or concerns, please consult with the instructor or TAs in this class.

- 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 education 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 deliver by an 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 presentation 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 guest 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.

ACADEMIC RESOURCES:

- E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.
- Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.
- Library Support: Various ways to receive assistance with respect to using the libraries or finding resources. Call 866-281-6309 or email ask@ufl.libanswers.com for more information.

- Academic Resources: 1317 Turlington Hall, Call 352-392-2010, or to make a private appointment: 352- 392-6420. Email contact: teaching-center@ufl.edu. General study skills and tutoring.
- Writing Studio: Daytime (9:30am-3:30pm): 2215 Turlington Hall, 352-846-1138 | Evening (5:00pm-7:00pm): 1545 W University Avenue (Library West, Rm. 339). Help brainstorming, formatting, and writing papers.
- Academic Complaints: Office of the Ombuds; Visit the Complaint Portal webpage for more information.
- Enrollment Management Complaints (Registrar, Financial Aid, Admissions): View the Student Complaint Procedure webpage for more information.
- UF Student Success Initiative: Visit https://studentsuccess.ufl.edu/ for resources that support your success as a UF student.

CAMPUS HEALTH AND WELLNESS RESOURCES:

- UF Whole Gator Resources: Visit https://one.uf.edu/whole-gator/discover for resources that are designed to help you thrive physically, mentally, and emotionally at UF.