Analysis, interpretation, and visualization of microbiological data
MCB 4794 / MCB 6796
3 credit hours
Academic Term: Fall 2024

Instructor:
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Office hours: by request via e-mail or phone
Office location: Microbiology and Cell Science Department – office #1247
The best way to contact me is via E-mail, or I can set up a time for individual Zoom sessions or in-person meetings.

Course Description This course will focus on the analysis and interpretation of microbiological data using R language and other command line tools with a series of examples that range in complexity. Students will analyze various types of microbiological data, including 16SrRNA gene sequencing, direct and indirect microbial growth measurements, and microbial bioproducts, among others. Finally, students will use good practices for data reproducibility.

Course Pre-Requisites: N/A
Textbook: There is no required text for the course. Online readings will be provided for each learning topic. A reading list is provided at the end of this document.

Course Learning Objectives. At the end of this course, each student will be able to:
1. Analyze microbiological data using state-of-the-art methods.
2. Select and apply the most appropriate analysis for various types of microbiological data.
3. Create and customize graphs using modern visualization tools to illustrate the variability and characteristics of microbiological data.
4. Use good practices for data reproducibility to document and share their work.
5. Write reports in html and pdf, combining the code and the data analysis.

e-Learning system: The course will be managed entirely through e-Learning in the Canvas system (one of two big orange buttons at **https://elearning.ufl.edu/**). If you are unfamiliar with this system, you need to become acquainted with it for this course. The LSS homepage contains tips and tutorials for students and computer requirements. You are responsible for becoming familiar with e-Learning in Canvas and ensuring that you have the appropriate browsers, settings, internet speed, etc. For any technical questions regarding Canvas, please visit the e-learning site (**https://elearning.ufl.edu/help/Student_Faq**) and/or the UF Help desk (**http://helpdesk.ufl.edu/**). They can address technical issues such as being unable to

view course materials, not being able to access the quizzes, not being able to send mail, etc. **All technical issues/questions/comments should go to the Help Desk first (352-392-HELP).** They are the experts. The Help Desk suggests that if you encounter any problem (error messages, etc.), you take a screenshot of the problem and save it. This will help the Help Desk in fixing your problem.

If you encounter a problem that the HELP DESK cannot fix, please request help from the Technical Support Center of the Microbiology & Cell Science Department. Please fill out your request at **http://microcell.ufl.edu/support/index.php**. The form will ask for your name, number, email, and location. In the location field, please indicate "online course."

Office Hours: Since this is a web-based course, office hours will be online. The office hours will be conducted via the Meetings function in e-Learning in Canvas or Zoom. Office hours are difficult to schedule since our students have such varied schedules. I will always be available to answer questions by email or set up an individual phone or Zoom conversation. Just contact me to arrange it.

Email and Announcements: All email communication regarding this course will be done through the mail function of E-learning in Canvas. This mail system is private and secure. You must check your E-learning Mail and Announcements **frequently** to stay updated on the course. Please check the course at least twice weekly to ensure you are not missing any critical communications. I will respond to your questions and emails promptly. Maintaining all email communication through Canvas instead of other email domains reduces the chance that discussions will get lost among outside accounts. When sending an email through e-Learning in Canvas, you can also forward the email to the recipient's ufl account. Please use this option if you have an urgent message. If you receive a course email (from Canvas) to your ufl account, please note that you cannot simply hit "reply" to the email. You must log into Canvas to respond through the mail function.

Topical outline of weekly modules (all times Eastern Standard Time)

Wk.	Dates	Week Topics
1	Aug 22	Install R and RStudio. Navigate through RStudio. Load data into RStudio.
2	Aug 30	Using AI to help coding
3	Sep 6	Making boxplots with ggplot2 Microbiome data visualization, relative abundance, and data transformation.
4	Sep 13	Evaluating biosurfactant production. Formatting data, normality test, power, and effect size. Assignment 1
5	Sep 20	Carbon dioxide emissions. Filtering, grouping, and summarizing information. Quiz 1

6	Sep 27	Gene expression. Log2 fold change and FRD in volcano plots. Assignment 2
7	Oct 4	Writing reports to show data characteristics and variability. Quiz 2
8	Oct 11	Testing pairwise differences with the t-test and more Assignment 3
9	Oct 18	Visualizing microbial community structure with ordination approaches Quiz 3
10	Oct 25	Testing microbial community differences with Multivariate Permutational Analysis of Variance Assignment 4
11	Nov 1	Microbial diversity measurements Quiz 4
12	Nov 8	Hierarchical clustering
13	Nov 15	Microbial growth with scatter plots and line Assignment 5
14	Nov 22	Correlations between microbes and environmental data Representing microbial communities with Heatmaps Assignment 6 – MCB 6796 only
15	Nov 29	Using web-based Galaxy toolkit
16	Dec 2	Wrapping up end of course

Grading Scale:

	Percentage/Points
A	90-100
A-	87-89.9
B+	84-86.9
B	80-83.9
B-	77-79.9
C+	74-76.9
C	70-73.9
C-	67-69.9
D+	64-66.9
D	60-63.9
D-	57-59.9
E	<=56.9

For more information on grade points and UF grading policies, see **https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx**

Assessments MCB 4794

Assignments (5 total; drop the one with the lowest score): This is a practical class. To provide all students with some hands-on experience, I designed assignments using real microbiological data from our lab and the literature.

The four highest-scoring assignments will be worth **70%** of your course grade. The lowest score of the five project assignments will be dropped. You will be notified in Canvas when each assignment is open.

Quizzes: Brief quizzes will ensure timely participation and progress in the course. All quizzes are open-book and unproctored. These quizzes are a *learning tool,* so you may take each quiz up to **three times each,** and only your **last score** of each week's quiz attempt will be recorded. Your quiz average will count for **30%** of your final grade. There will be a total of four quizzes. You can drop one lowest score. A quiz will not be re-opened or reset if it is interrupted by technical difficulties. (NOTE: A slow internet connection may affect timed quizzes, but it is your responsibility to use a connection at the speed suggested on the e-learning homepage.)

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Assignments (6 total; drop the one with the lowest score)

The five highest-scoring assignments will be worth **80%** of your course grade. The lowest score of the five project assignments will be dropped. You will be notified in Canvas when each assignment is open.

Quizzes (4 Quizzes; drop the one with the lowest score)

Your quiz average will count for **20%** of your final grade.

Course structure: The course is structured as 15 lessons or modules – one each week of the semester. Each week will cover a different topic. The topics build on each other, so to understand a topic in week 2, you must understand the material from week 1.

For each week's lesson, there will be several items to complete. Click on the link for each item. The first item will be the **learning objectives** for the week. Keep the learning objectives in mind as you learn the week's material. After reading the learning objectives, please review the week's material in the order presented. After you go through the material in the order presented, you are always free to return and visit any content. The introductory lecture will give an example of the types of course content and how it will be presented.

Grades and Grade Points

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

Attendance and Make-Up Work
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/.

Online Course Evaluation Process
Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. 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/**.

Academic Honesty
As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.” You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit 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." It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g., assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: **http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code**.

Additional comments regarding academic integrity:
Students are encouraged to discuss material with each other from the course, help each other understand concepts, study together, and even discuss assessment questions with each other. However, the following is considered academic dishonesty, and I expect that no student will ever do any of the following:

- Have another person complete a quiz or assignment in this course
- Copy another student's quiz or assignment in this course
- Collaborate with anyone during a quiz in this course
- Discuss the questions and answers of a quiz with other students while the quiz window is still open
- Manipulate and/or distribute any materials provided in this course for any purpose (including course lecture slides).
- Use any materials provided by a previous student in the course

Software Use:
All university faculty, staff, and students 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.

Services for Students with Disabilities
The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services, and mediating faculty-student disability-related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student, who must then provide this documentation to the instructor when requesting accommodation.

0001 Reid Hall, 352-392-8565, https://disability.ufl.edu/

Campus Helping Resources
Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services for currently enrolled students at no cost. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

• University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu

Counseling Services
Groups and Workshops
Outreach and Consultation
Self-Help Library
Wellness Coaching

• U Matter We Care, www.umatter.ufl.edu/
• Career Connections Center, First Floor JWRU, 352-392-1601, **https://career.ufl.edu/.**
• Student Success Initiative, http://studentsuccess.ufl.edu.

Student Complaints:

• Residential Course: **https://sccr.dso.ufl.edu/policies/student-honor-code-studentconduct-code/**.
• Online Course: http://www.distance.ufl.edu/student-complaint-process

Reading list

Phyton books - https://pythonbooks.org
Galaxy - https://usegalaxy.org/
Galaxy for Scientists - https://galaxyproject.org/scientist/
The R Project for Statistical Computing - https://www.r-project.org/
R for Data Science - https://r4ds.had.co.nz/