Analysis, interpretation, and visualization of microbiological data
MCB 6796
3 credit hours
Academic Term: Fall 2023

Instructor:
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Office hours: Tuesday and Friday, 3:00 – 5:00 PM
Office location: Microbiology and Cell Science Department – office #1247
The best way to contact me is via E-learning 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 Ranse, 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. We will always be available to answer questions by email or set up an individual phone or zoom conversation. Just contact us 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 28 – Sep 1	Setting up and installing the tools.
2	Sep 4 - 8	Microbiome data visualization, relative abundance, and data transformation.
3	Sep 11-15	Evaluating biosurfactant production. Formatting data, normality test, power, and effect size.
4	Sep 18-22	Carbon dioxide emissions. Filtering, grouping, and summarizing information.
5	Sep 25-29	Gene expression. Log2 fold change and FRD in volcano plots.
6	Oct 2-6	Writing reports to show data characteristics and variability.

7	Oct 9-13	Testing pairwise differences with the t-test and more
8	Oct 16-20	Visualizing microbial community structure with ordination approaches
9	Oct 23-27	Testing microbial community differences with Multivariate Permutational Analysis of Variance
10	Oct 30 – Nov 3	Microbial diversity measurements
11	Nov 6-10	Hierarchical clustering
12	Nov 13-17	Microbial growth with scatter plots and line plots
13	Nov 20-24	Correlations between microbes and environmental data
14	Nov 27 – Dec 1	Representing microbial communities with Heatmaps
15	Dec 4	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

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 **60%** of your course grade. The lowest score of the five project assignments will be dropped. The assignments are due roughly every other week and are staggered with the assigned quizzes. **The tentative assignment due dates are listed below and are subject to change.** You will be notified in Canvas when each assignment is open.

Project assignment times and dates (dropping the lowest score of one assignment):
These assignments will be open at 2 PM on Fridays (see dates below) and must be completed **next Friday**. Due at 11:59 PM:

	Open at 2 PM	Due at 11:59 PM
Assignment 1	September 8	September 15
Assignment 2	September 22	September 29
Assignment 3	October 6	October 13
Assignment 4	November 3	November 10
Assignment 5	November 17	November 24

Quizzes: Brief quizzes will ensure timely participation and progress in the course. All quizzes are open-book and unproctored. These short quizzes will be available at 2 PM on Fridays (see dates below) and must be completed by **Sunday evening BY midnight**. 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 **20%** 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.)

Following the close of each quiz and assignment window, you have 10 calendar days to contest your quiz grade in an email to me (i.e., a student cannot request a grade correction on quiz 2 during the last week of the course). Please note that you can ask a question about or discuss any quiz/assignment question at any time during the semester for understanding and education. Any requests for points must include a clear justification of your response. For example, please do not send an email saying, "tell me why I am wrong", but instead send an email saying, "this is why I think my response is a better answer or is as complete or appropriate."

Quiz times and dates (dropping 1 lowest score):

	Begins 2 PM:	Ends 11:59 PM
Quiz 1	September 15	September 17
Quiz 2	October 13	October 15
Quiz 3	November 10	November 12
Quiz 4	November 24	November 26

Final project assignment for graduate-level students
Graduate students will be required to write a final report (case study writing assignment) using their own data or any other data available on public databases. This assignment will be worth **20%** of the course grade. Each graduate student writes his or her own report. There will be no working in groups on this. All assignments for the report MUST be

entered into Canvas. For the formatting of the report, we will use the instructions from Trends in Microbiology: **http://www.cell.com/trends/microbiology/authors**. Each report must follow that format precisely - up to 3500 words and 100 references in length. The abstract must be between 100 and 120 words. Clarity and conciseness of language will be important for each report.

Course structure: The course is structured as 14 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.

Each week begins on Monday morning, which is the day by which a new week's worth of material will be posted. Every effort on my part will be made to post material before Mondays, but that may not always happen. Start by navigating to the Lessons page. Then, click on the appropriate week. 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/