Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring 2025
Year: 2025
Course Prefix: BIOL
Course and Section #: 3100-001
Course Title: Introduction to Data Analysis for Biologists
Credits: 3

Course Description

Introduces computational methods for analyzing and visualizing common biological data types, focusing on developing computational skills and best practices for working with biological data. Provides instruction in command-line computing and appropriate software environments to enable robust and reproducible analyses of varied data sets.

Course Attributes

This course has the following attributes:

☐ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☒ Discipline Core Requirements in Program
☐ Elective Core Requirements in Program
☐ Open Elective

Other: *Click here to enter text.*

Instructor Information

Instructor Name: Yu-Ya Liang

Student Learning Outcomes

1. Demonstrate proficiency in proper data entry, management, and storage for scientific research with an emphasis on reproducibility.
2. Convert untidy data to "tidy data" for analyses.
3. Discuss the basic principles of exploratory data analyses within appropriate software environments.
4. Evaluate the rationale behind using code to analyze data and present results.
5. Develop computational skills for processing common biological data formats, such as DNA sequences.
6. Create appropriate and meaningful data visualizations using appropriate software environments.
7. Integrate principles of experimental design, statistical modeling, hypothesis testing, and data visualization to critically analyze a unique data set.
8. Present a fully-reproducible report using a unique data set.

Course Materials and Texts

We will be using datasets provided by the instructors or contributed by students. Additional information and resources will be shared as the course progresses, depending on the direction we take. No textbook is required for this course. However, the following supplemental reading sources may be helpful:

- Big Book of R: https://www.bigbookofr.com
- R for Data Science: https://r4ds.had.co.nz
- Introduction to Data Science: http://rafalab.dfci.harvard.edu/dsbook/

Course Requirements

Course Assignments, Assessments, and Grading Policy

Grading Scheme

We will use a point system. The points you have accumulated by the end of the course determine your grade as follows:

Points	Letter Grade
700-800	A
640-699	B
560-639	C
480-599	D
<480	E

Points are based on:

- 10 Assignments - 20 pts each
- 4 Skills Tests - 100 pts each
- 1 Final Project - 200 pts

Assignments

These are shown on the course website (https://gzahn.github.io/data-course/). They (along with all necessary data and files) are also available in their respective directories on the GitHub repository (https://github.com/gzahn/Data_Course). They will generally consist of requiring you to complete a task using R and to upload your code as an R script to Canvas and/or GitHub. Some may vary. These assignments will not be accepted for credit after the due date.

Skills Tests

These will be similar to the sorts of tasks on the precedent assignments, and they will be open-source (you can use notes, internet, etc.). They focus on completing some data analysis tasks.

Final Project

Beginning early in the semester, we will decide on individual projects based on personal interest. Working with instructor feedback, you will come up with a question that interests you and will identify a data set that can address that question. You will then apply the data exploration and visualization skills you learn in class to prepare a well-formatted report that contains all the code and results of your analyses. You are encouraged to use your own data if you have any. Most importantly this project will require you to teach yourself new R skills using the resources we learn about (or any others). You will be required to learn analyses explicitly not covered in this course (Check the course website to see what we are covering), and to apply them correctly to your analysis and report.

Examples of unique topics could include, but are not limited to:

- Time-series analyses
- Genomic Profiling
- New statistical testing methods
- Metagenomic assembly
- Learning a new R package
- Unique visualization methods

Required or Recommended Reading Assignments
There is no required reading for this course. Additional reading materials and resources will be provided during class.

General Description of the Subject Matter of Each Lecture or Discussion
Module 1- The Command Line, File Paths, Git

- Installing Software
- Command-line
- Git version control
- File paths
- Wildcards and pattern matching
- Objects
- For-Loops

Module 2- Getting to Know R

- R Data types and conversions
- Reading and Writing Files
- Packages and Projects

Module 3- Visualizing a Data Set

- “Grammar of Graphics” ggplot
- dplyr verbs
- ggplot extensions

Module 4- Clean and Transform Data

- Tidy Data
- dplyr verbs
- tidyr verbs
- Data Wrangling
- Joins

Module 5- Getting More From R

- Writing Functions
- Conditional Execution

Module 6- Model Building and Testing

- Building and Testing Models
- Statistical Tests

Module 7- Communicating Your Results

- R-Markdown

- Reproducible Reports
- Proper Project Organization
- "There's an R-Package for everything"

Module 8- Putting it all together

- Data Analysis from raw to report
- Building a website with GitHub and R-Markdown

Required Course Syllabus Statements

Generative AI

In this course, you are encouraged to explore various tools and resources, including AI, to enhance your learning experience. AI can be a valuable aid in understanding complex concepts, generating ideas, and even debugging code. However, it is essential to remember that learning is a personal journey—understanding the material deeply and developing your skills is something only you can achieve.

When using AI tools, use them as a supplement to your own efforts. Avoid simply copying and pasting AI-generated content, as this will not contribute to your long-term growth or understanding. Instead, engage actively with the material: review and revise AI-generated outputs, cross-reference with course materials, and ensure that what you submit truly reflects your understanding.

Using Remote Testing Software

☒ This course does not use remote testing software.

☐ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities

Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity

At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX

Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation

UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.

To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.