Computational and Data Skills for Everyday Biology
Section 001—Winter 2026

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TAs: TA list
Canvas Page

Week	Date	Project Unit	Topics
1	Jan 6 Jan 8 Discussion:	What magic is my computer? ↓	1: Introduction to computation 2: Introduction to R & RStudio TOPIC
2	Jan 13 Jan 15 Discussion:		3: Introduction to RMarkdown 4: Plotting morphological data TOPIC
3	Jan 20 Jan 22 Discussion:		5: Mapping species distributions 6: Chromosomal data & speciation NO DISCUSSION
4	Jan 27 Jan 29 Discussion:	Building your computer toolbox ↓	7: 8: TOPIC
5	Feb 3 Feb 5 Discussion:		9: 10: TOPIC
6	Feb 10 Feb 12 Discussion:	You say two irises, I say three ↓	11: What is a species? 12: Delineating species by traits filtering joins
7	Feb 17 Feb 19 Discussion:		13: Delineating species geographically 14: Chromosomes and speciation NO DISCUSSION
8	Feb 24 Feb 26 Discussion:		15: Producing a scientific argument 16: something and a quiz? downloading internet data
9	Mar 3 Mar 5 Discussion:	Look at me on the internet! ↓	17: How the internet works 18: The (markup) language of the internet build your resume in HTML
10	Mar 10 Mar 12 Discussion:		19: Making an online presence 20: quiz and something? TOPIC

Course description

If a polar bear and grizzly bear can mate *and* form fertile offspring...then what is a species, actually? How do we *really* know the evolutionary relationships between humans and other primates? How can we measure and understand the evolution of complex traits like body shape across time? How do we take advantage of public databases and organize information effectively to use in our analyses? Tackling all these questions requires a strong facility in the computational and data skills that are now central to the practice of modern biology. In this course, we take a strong practical focus with the main objective being *the development of the core computational and data skills necessary for working with modern biological data*.

Formal statistical inference and modeling is only one tiny piece of the modern biologist's toolkit, and in this course we focus on the rest: using R and R Markdown to create reproducible reports; data cleaning, manipulation, and visualization in R; digitizing morphological data; analyzing large, heterogeneous, and messy datasets common across the field of biology; mapping species ranges and temporal data; building basic phylogenies, and interacting with key biological databases using web APIs.

Prerequisites

Prerequisites for this class are BIOL 005A, 005B, and 005C, a course in basic statistics, and a laptop computer on which software may be installed (Chromebooks are not suitable). No prior experience in programming is necessary for this course and extensive support will be provided on projects through the given project templates (see Appendix 2 for an annotated example).

Learning Outcomes

Our goal is that at the end of this course you'll be able to perform all of the following:

1. Import, clean, and visualize biological data using the R programming language.
2. Publish a scientific report to the web using R Markdown.
3. Independently perform computer-driven biological research techniques and explain the biological basis of such techniques.
4. Explain the value of computer-driven biological research techniques for the practice of modern biological science.

Course format

The course includes three hours of lecture and an hour of discussion ("computer lab"). During each lecture, we will spend approximately 30 minutes discussing the biological underpinnings of the project for that unit. We will spend the rest of lecture practicing the computational skills required to complete your project by working through examples together on our computers. Following lecture, you will work on projects independently and bring issues or errors you encounter to "computer lab" where hands-on practice and trouble-shooting will take place. Assuming an enrollment of 80 students with both in-class exercises and practical discussion sections, we will require two teaching assistants to successfully administer the course (see Appendix 1 for TA hour breakdown).

Grades

Grades are composed of five unit projects, a final exam, and participation and attendance in lecture and in discussion. The projects are due Sunday at midnight following the completion of each project unit. More details on the unit projects can be found below.

Grading

	Assessment	Percentage
Lecture	Unit Project 1	16
	Unit Project 2	16
	Unit Project 3	16
	Unit Project 4	16
	Unit Project 5	16
Discussion	Attendance & Participation	10
Exams	Final Exam	10
Course Total		100

A^+	97-100
A	93-96
A^-	90-92
B^+	87-89
B	83-86
B^-	80-82
C^+	77-79
C	73-76
C^-	70-72
D^+	67-69
D	63-66
D^-	60-62
F	59 or below

UNIT PROJECTS

Students will perform five unit projects, each one spanning two instructional weeks. Each project will focus on cultivating specific biological/computational core skills, and will culminate with a report written using R Markdown—a widely-used R library for publishing reproducible scientific reports. Students will be given report templates with sections to be filled in with their own code. A full example of one such template is provided in Appendix 2. Below, each project is briefly outlined along with its specific learning goals.

Project descriptions

What magic is my computer?

This project serves as an introduction to the core computational tools used in the course. Students will learn to prepare a simple report in R Studio and R Markdown. Students will be guided to customize and expand their report in a variety of ways, highlighting the features and possibilities of R Markdown and reproducible/automated reports.

Project learning goals:

1. Successfully download R and R Studio onto personal computer and confirm software runs.
2. Use R Studio to knit a sample R Markdown document to both PDF and HTML output formats.

You say two irises, I say three.

This project focuses on exploring morphological variation in flowering plants using the basic data manipulation skills introduced in lecture. Students will read in, summarise, and create a variety of plots focused on exploring species differences in a geographic context.

Project learning goals:

1. Use R to download biological data from GBIF.
2. Use R to plot morphological, geographic, and temporal data.
3. Correctly interpret plots to draw biological inferences about the relationships between *Iris* species.

Our family tree.

In this project, students will learn to obtain and analyse data from a real online genetic database (GenBank) in an evolutionary framework. Students will be introduced to using a database API, importing heterogeneous data into R, and creating a simple phylogenetic tree.

Project learning goals:

1. Use R to download GenBank data.
2. Align mitochondrial DNA sequences and use R to interpret and display evolutionary relationships among Hominidae.

Everything that rises must converge.

This project introduces the analysis of multidimensional traits via a study of the diversity of fish body shape. Students will learn to digitize body shape data from photographs, perform a basic morphometric analysis, and plot their results on a phylogenetic tree.

Project learning goals:

1. Use R to take measurements of trait data and plot results.
2. Use R to map trait data onto a provided phylogeny.

The messiness of real data.

Students will leverage the skills learned throughout the course and learn to handle "messy data" obtained from the citizen science database iNaturalist. Students will examine geographic and temporal patterns of a local taxon of their choosing, and prepare a report summarizing their findings.

Project learning goals:

1. Use APIs to interact with iNaturalist data and download occurrences of a species of interest.
2. Clean and organize messy datasets using Tidyverse tools.
3. Combine the skills learned so far and visualize how species distributions have changed through time

Evaluation

The course grade is earned through the completion of five Project Unit assignments (each worth 16% of the total grade), along with a final exam (worth 10%). The final exam will cover both biological and computational concepts covered throughout the quarter.

Unit Projects will be evaluated based on the rubric below. Ten points are earned if the file is submitted on time and in the correct format. The other 90 points are earned from three categories of equal weight. The first category (FILE RENDERS) is contingent on submitting an R Markdown file that successfully renders to HTML and PDF output. The next category is based on the accuracy and completeness of the exercise code (EXERCISE CODE). The final category is based on a written explanation of the observed data as it relates to the biological concepts we discussed during lecture (EXPLANATION).

	10—MISSING	20—INCOMPLETE	30—PRESENT
FILE RENDERS			
EXERCISE CODE			
EXPLANATION			

COURSE POLICIES

Expectations

1. **Be excellent to each other.** Our class is a community. It is vital that everyone feels welcome and that we all work together to create a safe space. This means listening to each other non-judgmentally and validating the experiences of others.
2. **Be considerate of each other.** We are all human beings—we all have good days, bad days, feelings, and frustrations. Let's make sure all of our interactions in class start with this understanding. Honor the experiences and thoughts of others: we never know what someone else is going through.
3. **Be respectful of each other.** Disagreement is natural. We are all different, and we should celebrate our differences and learn from one another. But we can only do this if we maintain respect for our classmates at all times. This means we always use kind words and inclusive language, and we never attack the character or experience of another person.

As your instructor, we will also abide by the outlined code of conduct above. In addition, we will:

1. Foster an inclusive environment for every student.
2. Return exams and enter grades within one week.
3. Respond to student emails within two business days. (See section on **Contact** for more.)
4. Maintain an open-door policy and make ourselves available for student questions, concerns, or feedback via email, office hours, or individual meetings.
5. Acknowledge that we will make mistakes, listen thoughtfully and respectfully to students that bring these mistakes to our attention, and change our behavior accordingly.

Attendance

We believe that attending class is essential to understanding the material and developing computational skills. Thus, part of your grade is earned by attending and participating in lecture. That being said, we understand that emergencies happen. You can miss up to three lectures with no penalty to your grade and you do not need to provide documentation or reasoning. **You must bring your R'Card to class.**

Poll Everywhere

Your participation grade is earned through Poll Everywhere. You may participate using the browser, app, or via text message. Let us know immediately if you experience any technical issues so we can resolve the problem.

Contact

Please use your UCR email address for correspondence. You can expect a response to emails within **two business days** of receiving them. While we may occasionally answer emails on Saturday, **we never respond to emails on Sunday**.

University Policies

Covid-19

If you have been exposed to Covid-19 you must fill out the **Daily Wellness Check Survey**. All students in this course, as a condition of physical presence in the classroom (including for exams or tests in the classroom or other location on the UCR campus), must be compliant with the UC SARS-CoV-2 (COVID-19) Vaccination Program (Program) at all times, as well as all other UCR Covid-related policies. Compliance is easily achieved by providing proof of Full Vaccination or submitting a request for Exception or Deferral as required by the Program. Students in violation of the Program or related directives of the instructor will be subject to disciplinary or other remedial action. The Policy can be found at: `https://policy.ucop.edu/doc/5000695/SARS-CoV-2_Covid-19`. More information on current Covid policy can be found at `https://campusreturn.ucr.edu/`.

Library Online

Access digital materials and other resources at the **UCR Library**.

ITS Help and Student Technology Support

ITS Student Technology Services supports 9 student computer labs, including 7 public labs and 2 nonpublic labs, with approximately 293 public lab hours per week (with reduced hours during breaks and summer) available for academic use by all UCR students.

Whether you need a machine to work on your paper, need to use specialized software required by your class, assistance with your R'Mail or iLearn accounts, getting on the network, or any other services used by UCR students, contact `bearhelp@ucr.edu`.

Academic Integrity

Honesty and integrity are fundamental values that guide and inform us as individuals and as a community at UCR. In this class we expect that students will take responsibility for their own learning and that they will familiarize themselves with the Principles of Academic Integrity as formulated by the Academic Senate of the University of California. Academic misconduct is any act that does or could improperly distort student grades or other student academic records. This includes cheating, fabrication, plagiarism, facilitating academic dishonesty, unauthorized collaboration, interference, and sabotage. Students found guilty of any academic misconduct will receive a reduced final course grade. For additional information please refer to the academic senate guidelines (http://senate.ucr.edu/bylaws/?action=read_bylaws&code=app&section=06%20).

Academic Misconduct

In addition to the course conduct policies outlined by your professor in the Course Syllabus in the online classroom, please review the Graduate Student Handbook. It is the responsibility of each student to be familiar with the definitions, policies, and procedures concerning academic misconduct. Please revisit our **Academic Integrity Policies** and Procedures for more information. This site also defines misconduct, provides examples of prohibited conduct, and explains the sanctions available for those found guilty of misconduct.

Plagiarism

Plagiarism is the most common form of academic misconduct at UCR. It is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit. This includes the copying of language, structure, or ideas of another and attributing (explicitly or implicitly) the work to one's own efforts. Plagiarism means using another's work without giving credit.

For more information about plagiarism, see **Academic Integrity Policies and Procedures**.

Student Accommodations

UC Riverside is committed to providing equal access to learning opportunities to students with documented disabilities. To ensure access to this class, and your program, please contact the Student Disability Resource Center (SDRC) to engage in a confidential conversation about the process for requesting accommodations in the classroom. More information can be found on sdrc.ucr.edu. If you are a student registered with the SDRC, please ensure you request your quarterly accommodations through rability.ucr.edu.

Reasonable Accommodation for Disabilities

UCR is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course should contact their professor as early in the semester as possible. Students with disabilities must be registered with the Student Disability Resource Center prior to receiving accommodations in this course.

If you have a disability and you would like to make a request for reasonable accommodation, please see the Graduate Student Handbook or get in touch with the **Student Disability Resource Center**.

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy- related or childbirth-related issues, please contact me as soon as possible to discuss your options. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability. Learn more about the rights of pregnant and parenting students by consulting the **Office of Diversity, Equity, and Inclusion**.

Title IX Resources

For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24/7, counseling services, mutual no contact orders, scheduling adjustments, and disciplinary sanctions against the perpetrator. Please see the Title IX website for more information. They can be reached at (951) 827-7070. You can also **file a report**.

Student Needs

Student Health Services, **Counseling & Psychological Services (CAPS)**, Residential Life, Dining, and **R'Pantry** are available to support students.

Religious Holidays

It is the policy of the University to make a reasonable attempt to accomodate religious observances. It is the responsibility of the student to make alternate arrangements with the instructor at least one week prior to the actual date of the religious holiday, or during the first week of classes in the even that the holiday occurs during an exam.

Copyright Policy

It is illegal to download, upload, reproduce, or distribute any copyrighted material, in any form and in any fashion, without permission from the copyright holder or his/her authorized agent. UCR expects all members of its community to comply fully with federal copyright laws.

Registration and Withdrawal

If you choose to withdraw from this course, you must complete the appropriate University form and turn the form in before the deadline. Deadlines are shown in the **Academic Calendar**, which is available from the Office of the Registrar.

Appendix 1

Estimate of Minimum Teaching Assistant Hours Needed

The following estimates assume an enrollment of 80 students, with three hours of lecture and one hour of discussion per week.

Regular Weekly TA Hours

- One hour of computer lab $\times$ six sections (14 students/section) = Six hours per week
- Six hours of lecture and exercises (three hours $\times$ two TAs) = Six hours per week
- Four TA office hours = Four hours per week
- Student emails/discussion board = Four hours per week

Weekly Total: 20 hours $\times$ 10 weeks = 200 total TA hours per quarter in weekly tasks

Grading Hours

- 30 minutes per assignment $\times$ 80 assignments = 40 hours per project

Grading Total: Five projects $\times$ 40 hours per project = 200 grading hours

Course Total: Total TA hours needed = 200 weekly hours + 200 grading hours = 400 TA hours

Therefore, we will require two TAs at 220 hours max per quarter each