

Syllabus — Advanced Biometry (BIOL 710)
Spring 2024

Course units: 3
In-person synchronous MW 10:00 am – 12:15 pm HH 440 + remote asynchronous activities

LAND ACKNOWLEDGMENT
We acknowledge that the land in which we are now working, studying, and learning on is the ancestral and unceded territories of the Ramaytush Ohlone and the Coastal Miwok (who, along with the Southern Pomo, are organized as the Federated Indians of Graton Rancheria). This land was and continues to be of great importance to the Federated Indians of Graton Rancheria, and we continue to benefit from the use and occupation of this land.
Learn more about native land: https://sfsuais.sfsu.edu/land-acknowledgement

INSTRUCTOR CONTACT INFORMATION
Prof. Jenna Ekwealor (*she/her*)
Email address: ekwealor@sfsu.edu (preferred means of contact, or through Canvas)

Prof. Pleuni Pennings
Email address: pennings@sfsu.edu

Email and Canvas Policy
We will send information and announcements pertinent to the class through Canvas. We expect you to regularly check your SFSU email and the course Canvas site. If you wish to contact us by email, please also do so using Canvas or your SFSU email account; messages from other accounts may be diverted to junk mail.

Office hours
Jenna Ekwealor: Tuesdays 11-12 HH 432 or on Zoom.
Pleuni Pennings: TBD and *by appointment*
We aim to have ample time for student questions and discussion during class. For general content questions outside of that time frame, please consider posting to the Discussion board on Canvas so that others can learn from your question, too. If scheduled office hours don't work for your schedule, we can meet by Zoom or in-person another time. Please don't hesitate to reach out!

A note: *These are not normal times, and we don't plan to pretend that they are normal. We expect that some of you are experiencing unprecedented stress and perhaps insecurity or instability. Please let us know how we can support you or help locate resources so that you can succeed in your studies and be healthy both physically and emotionally.*

TEXTBOOKS/MATERIALS

Required materials:

1. **Texts:**
   - *Communicating with Data* by Deborah Nolan and Sara Stoudt. Access eBook for FREE from SFSU Library OneSearch by clicking here.
   - Additional required readings provided on the syllabus and on Canvas
   - *Biostatistics Laboratory* Lab Manual Access FREE online.
   - Course GitHub page: https://github.com/jenna-tb-ekwealor/BIOL710AdvBiometry/

2. **Laptop computer** with R and RStudio installed. Throughout the semester, we may ask you to install other software such as GitHub Desktop, Aliview, and Image J, to name a few (we will provide installation instructions and details in Lab). You can check out a laptop for free from SFSU Library for the semester (more info here) or for the day from the Research Commons help desk on the first floor of the Library.

COURSE OVERVIEW

Biometry is another name for "statistics for biology." However, in addition to statistics, we will also cover data management, coding, reproducibility, and some general analysis approaches that aren't necessarily "statistics." Most of this course will be based in the coding language `R`. Accordingly, we will start with a foundation in coding in `R` and we will then survey biological statistical data analysis topics in 5 "blocks" of content. (I) Introduction to Statistics in `R`, (II) Linear and Logistic Modeling, (III) Multivariate Statistics and Diversity Indices, and (IV) Spatial and Phylogenetic Diversity. Block V, the final unit, is dedicated to an independent project in Lab while the Lectures focus on refining essential skills and knowledge for real-world application. After completing this course, students can expect to have gained proficiency in several common topics and tools in statistics for biology and a reproducible analysis customized to your specific research project.

Pre-Labs & Assessments (asynchronous) There will be two types of asynchronous activities required of you in this course: Pre-Labs and Quizzes. Pre-Labs are due each class week on Monday at the start of class, except for Week 1, when it is due Wednesday at the start of class. Quizzes are at the end of each Block, will be remote, open-note, and you will have several days to complete them. Quiz content will be based on topics discussed or worked on in class. See Canvas for more details on these asynchronous assignments and assessments..

Lecture and Labs (synchronous, in-person) Lectures will all be in-person and readings (if any) will be related to course content.We strongly recommend you keep up with the readings, preferably before corresponding lectures. Research shows that previewing content facilitates learning. Even if you don't have time to sit down and read thoroughly, just scanning the text before Lecture has benefits. Readings may also help you prepare for Quizzes.

Labs will be worked on in small groups during each class period. Though we aim for you to be able to complete labs in class, they are due by 11:59 PM that night in case you need more time. Lab exercises are generally to be completed in `R` or some other analysis software and submitted via Canvas. See Canvas for details.

COURSE LEARNING OUTCOMES:

Students who successfully master the course content will be able to:

- List key statistical and computational concepts in biological data science
- Interpret results from advanced statistical methods
- Describe reproducible research practices and effective communication strategies
- Apply statistical methods to diverse data types
- Develop and carry out an independent data analysis project

GRADING POLICIES
Assignments, Evaluation/Assessment, and Grading:

Grade	Points
A	90-100
B	80-89
C	70-79
D	60-69
F	≤59

100 points total.

1. Participation **7 points**
(30 synchronous Lectures, drop 2; 0.25 points each)

Your participation is important, and your perspective and questions are valuable. Discussing difficult or new concepts facilitates learning, helps you discover how to effectively communicate views, encourages careful reading, assists instructors in identifying areas that need clarification, and improves everyone's understanding of complex topics.

Participation and skills will be evaluated in terms of the following criteria for 0.25 points per session: (1) you are prepared, (2) you are engaged, (3) you are an active participant, (4) you demonstrate competence and/or improvement in skills, (5) you are respectful to your colleagues.

2. Quizzes **20 points**
(5 quizzes, 4 points each)

Quizzes are "open-book" by nature and will be mixed format including short essay questions. Quizzes will be available for several days (see dates for each on the schedule below), but once you start a quiz, you will have up to 2 hours to complete it.

3. Pre-Labs **12 points**
(12 assignments, 1 point each)

Each week you will have a Pre-Lab assignment to be completed and submitted in `R`.
3. Lab Activities **45 points**

(21 assignments, drop 1; 2.25 point each)

Each class period you will have a Lab activity to be completed in small groups and submitted via Canvas.

4. Final Project **16 points**
(4 components, 4 points each)

The final project will consist of a fully reproducible and annotated data analysis and visualization for your own dataset or research question (with simulated data) `R` Markdown. Final projects will also include a Lightning Talk during the last week of class.

LATE SUBMISSION POLICY

Late Pre-Labs and Labs will be subjected to a 0.25 points per day deduction unless approved prior to the due date. You are permitted to drop one missed Lab. Late Final Project components (4 total, each worth 4 points) will be subjected to 1 point per day deduction unless approved prior to the due date. Late Quizzes cannot be accommodated. Please contact us if you have extenuating circumstances so we can come up with a make-up or alternative plan.

ETHICS AND ACADEMIC HONESTY POLICY

When you choose to take a course with an instructor, we enter into an ethical contract with each other. We should assume that instructors will design course activities and act in good faith to help you learn; and that you, as the student, will complete the course work yourself and to the best of your ability. That means that we won't try to trick you or mislead you, and all your course submissions should reflect your own, independent or group work. For the purposes of this class, we are choosing to approach the use of generative AI (e.g. ChatGPT) following NSF's recently released guidelines. In brief, we ask that you disclose its use and the nature of how it was used in your work.

Spring 2024 Schedule (*subject to change*)

Week	Lecture	Lab	Readings	Assessments	Instructor
Block I: Introduction to Statistics in R					
Week 1 Week of Jan. 29	**Monday Jan. 29:** Introduction to statistical thinking and R basics **Wednesday Jan. 31:** Descriptive statistics and exploratory data analysis	**Exploring data with R** learnR pre-lab due: **Jan. 31** 1. Introduction to R (Lab Ch. 1) 2. Data Visualization (Ch. 3)	1. *Communicating with Data* Ch. 3: Describing Data LINK		Jenna
Week 2 Week of Feb. 5	**Monday Feb. 5:** Introduction to inferential statistics **Wednesday Feb. 7:** Probability distributions + GUEST LECTURE	**Probability and sampling** learnR pre-lab due: **Feb. 5** 1. Sampling (Ch. 2) 2. Probability Distribution (Ch. 4)	1. *A biologist's guide to statistical thinking and analysis* (Fay and Gerow 2005–2018) LINK	**Quiz 1** Feb. 7 – 11	Jenna
Block II: Linear and Logistic Modeling					
Week 3 Week of Feb. 12	**Monday Feb. 12:** Hypothesis testing **Wednesday Feb. 14:** The binomial distribution + GUEST LECTURE	**Hypothesis testing and binomial distributions** learnR pre-lab due: **Feb. 12** 1. Hypothesis Testing (Ch. 5) 2. Binomial Distribution (Ch. 6)			Pleuni
Week 4 Week of Feb. 19	**Monday Feb. 19:** GLMMs **Wednesday Feb. 21:** The normal distribution + GUEST LECTURE	**GLMMs and the normal distribution** learnR pre-lab due: **Feb. 19** 1. GLMMs 2. The Normal Distribution (Ch. 7)	1. Martinez et al. 2017. Deconstructing the landscape of fear in stable multi-species societies. LINK		Pleuni
Week 5 Week of Feb. 26	**Monday Feb. 26:** T-tests **Wednesday Feb. 28:** Introduction to linear regression + GUEST LECTURE	**Logistic modeling** learnR pre-lab due: **Feb. 26** 1. T-test (Ch. 8) 2. ANOVA (Ch. 9)		**Quiz 2** Feb. 28 – Mar. 3	Pleuni

Block III: Multivariate Statistics and Diversity Indices					
Week 6 Week of Mar. 4	**Monday Mar. 4:** Advanced linear regression **Wednesday Apr. 3:** Introduction to multivariate statistics	**Multivariate statistics** learnR pre-lab due: **Mar. 4** 1. 2-way ANOVA (Ch. 10) 2. Correlation (Ch. 11)			Pleuni
Week 7 Week of Mar. 11	**Monday Mar. 11:** Dimensionality reduction **Wednesday Mar. 13:** Clustering methods	**Clustering methods** learnR pre-lab due: **Mar. 11** 1. TBD 2. TBD			Pleuni
Week 8 Week of Mar. 18	**Monday Mar. 18:** Introduction to diversity indices **Wednesday Mar. 20:** Population and community diversity	**Diversity metrics** learnR pre-lab due: **Mar. 18** 1. TBD 2. TBD		**Quiz 3** Mar. 21 – 31	Pleuni
Block IV: Spatial and Phylogenetic Diversity					
Week 9 Week of Mar. 25	**Monday Mar. 25:** SPRING BREAK NO CLASS **Wednesday Mar. 27:** SPRING BREAK NO CLASS	SPRING BREAK NO CLASS			
Week 10 Week of Apr. 1	**Monday Apr. 1:** CESAR CHAVEZ DAY NO CLASS **Wednesday Apr. 3:** Mapping and spatial analyses	**Mapping and spatial analyses** learnR pre-lab due: **Apr. 3** 1. Introduction to spatial data and mapping in R (Ch. 12)			Jenna
Week 11 Week of Apr. 8	**Monday Apr. 8:** Introduction to Phylogenetic trees and tree thinking	**Phylogenetic trees and comparative phylogenetic methods** learnR pre-lab due: **Apr. 8**			Jenna

	Wednesday Apr. 10: Phylogenetic comparative methods	1. Supertrees in R (Ch. 13)			
Week 12 Week of Apr. 15	**Monday Apr. 15:** DNA Sequences and sequence alignment **Wednesday Apr. 17:** Phylogenetic models and Bayesian inference	**Alignment and tree inference** learnR pre-lab due: **Apr. 15** 1. Phylogenetic tree inference (Ch. 14)		**Quiz 4** Apr. 17 – 21	Jenna
Block V: Independent Project					
Week 13 Week of Apr. 22	**Monday Apr. 22:** Reproducible research practices **Wednesday Apr. 24:** Reproducible research practices	**Independent project formulation and planning** learnR pre-lab due: **Apr. 22** 1. Version control with Git and Github	1. *Ten Simple Rules for Reproducible Computational Research* (Sandve 2013) LINK		Jenna
Week 14 Week of Apr. 29	**Monday Apr. 29:** Datasets **Wednesday May 1:** Statistical test	**Independent project data cleaning and analysis** 1. Data cleaning and analysis organization 2. Applying statistical tests	1. *Tidy Data* (Wickham 2014) LINK		Pleuni, Jenna
Week 15 Week of May 6	**Monday May 6:** Effective communication of results **Wednesday May 8:** Creating publication-ready figures + GUEST LECTURE Dr. Sara Stoudt	**Visualizations and interpretation** 1. Visualizing data and results 2. Interpretation of results and drawing conclusions	1. *Communicating with Data* Ch. 4: Communicating Through Statistical Graphs LINK	**Quiz 5** May. 8 – 12	Jenna
Week 16 Week of May 13	**Monday May 13:** Lightning talks **Wednesday May 15:** Lightning talksx	**Final presentations** 1. Prep for lightning talks 2. Lightning talks			Pleuni, Both

Names, Pronouns, and Gender: *If you have changed your name (officially or unofficially) from what appears in Canvas, go by a nickname, or wish to specify your pronouns, please feel free to tell me. Everyone in this class has the right to be addressed and understood by their right name and their gender identity.*

STUDENT ACCESSIBILITY SERVICES:
Students with disabilities are encouraged to contact me in private to discuss their services and accommodations. This information will be kept confidential and will not affect your grade. Also, students who think they could use support from the Student Accessibility Services for temporary or permanent conditions, or if you suspect you might have a learning disability, please contact their office: (510) 436-2429. Students have the right to request reasonable modifications to college requirements, services, facilities or programs if their documented disability imposes an educational limitation or impedes access to such requirements, services, facilities or programs. A student with a disability who requests a modification, accommodation, or adjustment is responsible for identifying himself/herself to the instructor and, if desired, to the SAS office. Students who consult or request assistance from SAS regarding specific modifications, accommodations, adjustments or use of auxiliary aids will be required to meet timelines and procedural requirements established by the SAS office.

What About Stress, Family, Illness, and Other Personal Issues that Affect School?
We are all human, and we all experience stress, illness, grief, and other personal and financial issues. I want you to know that there are resources on campus and in the community to help. It can often be hard to reach out and ask for help because of stigma, worries we will be seen as "weak," or a host of other issues. Please know that I care about my students, and that I firmly believe it often takes far more courage to ask for help than not to. I urge you to read about these resources and use them if needed. In addition, remember that I am willing to talk to students about make-up exams or extensions (see policies).

RESOURCES:
Mental Health Counseling Services: caps.sfsu.edu, confidential Personal Counseling for SF State students
Student Health Services: health.sfsu.edu
Disability Programs and Resource Center: access.sfsu.edu, (415) 338-2472, (415) 335-7210 (video phone)
Career Services & Professional Development Center: cob.sfsu.edu/resources/career-services
Veteran's Services: veterans.sfsu.edu
Financial Aid: financialaid.sfsu.edu
Tutoring and Academic Support Center: tutoring.sfsu.edu/, free tutoring for SF State students
Biology Advising: biology.sfsu.edu/advising/advisors