BILD 5 Syllabus

Spring 2025

COURSE DESCRIPTION

Data Analysis and Design for Biologists (4 credits)

This course is a practical introduction to information literacy, experimental design, and data analysis for biologists. Students will be introduced to coding, data management, and quantitative analysis using the R programming language and the RStudio IDE. However, this is not a traditional statistics course and no math prerequisites are required. Rather this course focuses on practical skills related to effectively asking and answering biological questions with data.

COURSE LEARNING OUTCOMES

1. ***Create*** *testable hypotheses addressing valid biological questions.*
2. ***Evaluate*** *the credibility and value of relevant scientific information.*
3. ***Design*** *experiments that effectively test hypotheses.*
4. ***Construct*** *figures that effectively communicate data.*
5. ***Perform*** *appropriate quantitative and statistical analyses on experimental data.*
6. ***Interpret*** *the results of quantitative statistical models and associated analyses.*
7. ***Utilize*** *the R programming language for scientific data analysis and graphing.*
8. ***Combine*** *the elements of a complete investigative cycle in a student designed project.*
9. ***Explore*** *the modern intersection between different subfields of biology, technology, and data science.*
10. ***Examine*** *the ethical responsibilities of scientists when creating and communicating scientific evidence.*

CONTACT AND SCHEDULING INFO

Dr. Keefe Reuther (he/him/his) ***(Please call me Keefe)***

Email: kdreuther@ucsd.edu (please put BILD 5 in the subject line)

PREREQUISITES

None! And you don’t need any experience coding or working in a lab!

COURSE FORMAT

This is an in-person course. You are expected to attend two lectures per week (Tuesday and Thursday), one discussion section per week (your registered section), and the in-person midterm and final exam. Office hours are also held in person. Some course components, such as discussion board prompts and certain assignments, are completed asynchronously online through Canvas.

COURSE MATERIALS

There is no required textbook for this course. All course materials, including lecture slides, coding resources, and readings, will be provided to you at no cost through Canvas and the UCSD DataHub.

TECHNOLOGY REQUIREMENTS

You will need access to a device that can access a web browser (e.g., Chrome, Safari, Firefox). This will be to access Canvas, Zoom, and the UCSD DataHub. While any connected device can typically accomplish this (smart phone, tablet, laptop), it is highly recommended that you use a laptop or a desktop computer for connecting to the UCSD DataHub. Trust me, you don't want to write code from your phone! Note that Chromebooks work perfectly well for this course.

TECHNOLOGY POLICY

You are welcome to bring technology (laptops, tablets) into lecture, but please make sure it is not disruptive to those around you — particularly students sitting behind you who may be distracted by your screen. Technology is not required in lecture but is recommended for discussion sections, where activities are built around coding in R.

QUESTIONS?

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Find our class signup link at: Piazza — BILD 5 SP26

COURSE EXPECTATIONS

It is your responsibility to read this syllabus thoroughly and to understand what is required of you in this course. If you are unsure about any policy, deadline, or expectation, it is your responsibility to ask well ahead of any due date. You can ask in person during office hours, through a teaching assistant, or on Piazza.

Before reaching out with a question, please check whether the answer is already in this syllabus or on Canvas. Email response times for myself and the teaching assistants are

limited to business hours. A late-night email will not be read or responded to until the next business day. That said, if something urgent comes up — for example, you are sick and cannot make it to an exam — send the email right away, even if it is the middle of the night. We may not read it until the morning, but the timestamp will show us that the situation arose before the exam.

POLICY ON COLLABORATION

Working together is good! Science is a social act and we want this course to mirror the real world of biology. That being said, we also need to adhere to our pledge to act with integrity. Therefore, you may help each other in general. This means explaining concepts, definitions, processes, etc. to each other. You may also talk about and share code with each other. Copying and pasting code is an everyday tactic.

However, ***your final answers and responses must be your own and you are responsible for understanding and creating/evaluating everything you submit for this course.*** There is to be absolutely no sharing of answers. We will frequently ask for you to annotate your code and explain what your code is doing. This, as well as all other written work, must be original. All assignments (including RMarkdown pdfs) will be run through a plagiarism checker. At the end of the day, you are here to learn this material so you can be a better biologist. Focus on learning and grades will come as an indirect, wonderful consequence.

COURSE CALENDAR

Week	Lecture Topics
1	Why are science, statistics, and programming necessary? Ok, but why are they necessary in biology? Data Part 1: types and structures/variables and samples
2	Data Part 2: The importance of visualizing data Data Part 3: Central tendency and variation
3	Data Part 4: Normality — the Central Limit Theorem and confidence intervals
4	Hypothesis Testing Part 1: Writing a clear alternative and null Hypothesis Testing Part 2: Testing your assumptions Hypothesis Testing Part 3: Test statistics and quantifying differences
5	Hypothesis Testing Part 4: How power, p values, effect size, and sample size affect uncertainty
6	*Monday Midterm — in-person during lecture* Hypothesis Testing Part 5: Tests of differences, t-tests, ANOVA and Chi squared
7	Hypothesis Testing Part 6: Correlation and quantifying similarities Hypothesis Testing Part 7: Making predictions with linear regression
8	Experimental Design Part 1 — Which design to choose?
9	*Monday Memorial Day Holiday — NO A01 DISCUSSION SECTION* Experimental Design Part 2 — The importance of sampling Experimental Design Part 3 — Practical and ethical considerations
10	What's next? Multivariate models, resampling, ordination, bioinformatics… Labs, research, careers, and the issues facing modern science culture. Catch up, review, and term project help
FINAL EXAM	**Tuesday, 06/09/2026; 3p–6p PST — THIS IS MANDATORY IN-PERSON**

DISCUSSION SECTION CODING TOPICS

Week	Coding Topic
Week 1	Objects and Functions — Running your first line of code
Week 2	Introduction to Datahub and RStudio Importing data, saving files, running code
Week 3	Data visualization
Week 4	Tidyverse and data wrangling/cleaning

Week	Coding Topic
Week 5	Makeup week
Week 6	Test for normality; t-test
Week 7	ANOVA
Week 8	Linear regression and correlation
Week 9	Bringing it all together
Week 10	Work on term project

GRADING

Component	Weight
Lecture participation (4 missed lecture classes OK)	5%
Quizzes (4x — drop lowest score)	15%
Coding Assignments (8x — drop lowest score)	15%
Discussion Board Prompts (4x — drop lowest score)	5%
Term Project	25%
Midterm (score replaced by final exam if the final exam % is higher)	15%
Final Exam	20%
SETs + Research Surveys (extra credit)	up to 1%

A+	97–100%	B+	87–89%	C+	77–79%	D+	67–69%	F	0–59%
A	93–96%	B	83–86%	C	73–76%	D	63–66%		
A-	90–92%	B-	80–82%	C-	70–72%	D-	60–62%		

Grade cut-offs will never be shifted and there is no rounding of points.

DISCUSSION BOARD PROMPTS

In weeks 1, 3, 5, and 8 there will be a discussion prompt placed in the Discussions section of Canvas by the preceding Friday night. For a response to count for credit, it

must be original, substantive, and properly cited (if necessary). Generally, this means a small paragraph. Replies of “I agree” do not count as substantive.

Any use of generative AI must include a short, single statement that includes the AI tool used (e.g., ChatGPT) and what you received from it (e.g., help identifying an error in my code). Your lowest score will be dropped.

QUIZZES

During weeks 2, 4, 7, and 9 there will be a **20 minute in-person quiz given during your registered discussion section.** Each quiz is non-cumulative and your lowest score will be dropped. **YOU MAY NOT USE AI OR COLLABORATE WITH OTHER STUDENTS DURING A QUIZ. IT IS CLOSED NOTE.**

FINAL EXAM AND MIDTERM — MANDATORY AND IN-PERSON

- For the final exam, you will have 3 hours. This will be a cumulative exam. You may bring 1 NOTE CARD no larger than 4”x 6” with information of your choosing on both sides. It can be printed or handwritten. It cannot be shared or sold to others.
- The midterm will be a miniature version of the final, held in-class for 80 minutes. Practice exams are available on Canvas. If your final exam score is a higher % than your midterm, the higher % will replace your midterm score.

TERM PROJECT

This project will allow you to go through an entire investigative cycle on your own, from the design of your own question through being provided with simulated data to analyze, interpret and report. You will receive instructor feedback after each step. Please take heed of the feedback as grading will get progressively more stringent. See individual rubrics on Canvas for more information. Each step should be adequately researched and cited using core principles of scientific literacy. While the data is fake, your project should be realistic, relevant, and at least moderately original. This should be a product that you can put in your portfolio for future interviews. Who knows? Maybe it’ll inspire your next research project in graduate school!

LATE ASSIGNMENT POLICY

Lecture Participation

Determined by check-ins and check-outs in class via Mentimeter.

Action: No action is necessary. You can miss up to 4 check-ins and check-outs (two weeks) and still maintain 100% attendance, regardless of the reason. This is meant to help you in case of illness, family emergency, phone running out of battery, or any other reason you miss class. ***Please do not ask me if you can make-up or receive credit for missed attendance.*** It is your responsibility to keep track of the number of class sessions you miss.

Discussion Board, Final Project

Submitted late?

Action: A 2% penalty applies for each hour the assignment is late. Any unexcused assignment turned in more than two days late can't receive a score higher than 50%. If you face an unavoidable issue (e.g., hospitalization), contact Keefe via email (

kdreuther@ucsd.edu) promptly. Keep in mind, **technical difficulties right before the deadline are not valid reasons for exceptions.** Your lowest scores for discussion board and quizzes will still be dropped.

Quizzes, Midterm & Final Exam

Can't attend due to unavoidable circumstances?

Action: All are in-person, synchronous, and mandatory. It will not be rescheduled unless you qualify for an OSD accommodation or a university sanctioned event being chaperoned by university personnel. If you can't attend due to an unavoidable issue (e.g., illness), notify Keefe (

kdreuther@ucsd.edu) immediately and follow the University's incomplete grade policy to make alternate arrangements. This must be done prior to the start time of test time.

Extra Credit

Student Evaluations of Teaching (SETs): If 80% of enrolled students complete the end-of-quarter university course evaluations, everyone in the class will receive extra credit.

Research Surveys: Students may also earn extra credit by participating in approved research surveys. To receive credit, you must complete both the pre-survey (available during Weeks 1–2) and the corresponding post-survey (available during Week 10 and Finals Week). The cumulative extra credit from SETs and research surveys combined is up to 1%.

Regrade Policy

For any exam administered through Gradescope, submit your regrade request directly through the Gradescope platform. For all other assignments, use the official Regrade Request Form (a Google Form linked on the course Canvas page).

ACADEMIC INTEGRITY POLICY ON GENERATIVE AI

Attribution and Documentation

Any use of generative AI must include a short, single statement that includes the AI tool used (e.g., ChatGPT) and what you received from it (e.g., help identifying an error in my code).

Any evidence of use of AI without proper citation is a violation of academic integrity and will be treated as such. Keep in mind that I support the appropriate use of generative AI on asynchronous assignments to augment and facilitate your learning.

Disclaimer on Generative AI

Generative AI, such as LLMs, can sometimes produce misleading or false information. Be especially wary with images. You're accountable for every submission, AI-assisted or not. ALWAYS fact-check AI-generated content before submission.

Student Resources for Support and Learning

Library Help

Ask a Librarian
Library Help: Course Reserved, Connecting from Off-Campus and Research Support

Learning Resources

- — Improve writing skills and connect with a peer writing mentor.
- — Peer-assisted study sessions through the Academic Achievement Hub.
- — Drop-in and online tutoring through the Academic Achievement Hub.
- — Address learning challenges with a metacognitive approach.
- — Intellectual and personal development support.
- — Peer mentor program providing information, resources, and support.

Student Resources

UC San Diego (as an institution) and I (as a human being and instructor of this course) are committed to full inclusion in education for all persons. Services and reasonable accommodations are available to students with temporary and permanent disabilities, to students with DACA or undocumented status, to students with health or other personal concerns, and to students with other kinds of support needs. Please feel free to let me know if there are circumstances affecting your ability to participate in class.

Basic Needs

Any student who has difficulty accessing sufficient food to eat every day, or who lacks a safe and stable place to live, and believes this may affect their performance in this course, is encouraged to contact: (858) 246-2632.

Basic Needs Hub | foodpantry@ucsd.edu | basicneeds@ucsd.edu

CAPS Student Health and Well-Being

CAPS provides services like confidential counseling and consultations for psychiatric services and mental health programming.

Community Centers

As part of the Office of Equity, Diversity, and Inclusion, the campus community centers provide programs and resources for students. Community Center List

Triton Concern Line

Report students of concern at (858) 246-1111. Student Affairs Case Management Services

Undocumented Student Services

Undocumented Student Services provides programs and services designed to help students overcome obstacles that arise from their immigration status and support them through personal and academic excellence.

Accessibility

Students requesting accommodations for this course due to a disability must provide a current Authorization for Accommodation (AFA) letter issued by the

Office for Students with Disabilities (OSD), which is located in Pepper Canyon Hall Suite 300. Students are required to present their AFA letters to Faculty (please make arrangements to contact me privately) and to the OSD Liaison in the department in advance so that accommodations may be arranged.

Contact at 858.534.4382 or osd@ucsd.edu

Inclusion

UC San Diego (as an institution) and I (as a human being and instructor of this course) are committed to full inclusion in education for all persons. Services and reasonable accommodations are available to students with temporary and permanent disabilities, to students with DACA or undocumented status, to students with health or other personal concerns, and to students with other kinds of support needs. Please feel free to let me know if there are circumstances affecting your ability to participate in class. Some resources that might be of use include:

- — 858.822.3542 | diversity@ucsd.edu
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Technical Support

For help with accounts, network, and technical issues, contact the Service Desk.

For help connecting to electronic library resources: Connect to Library Resources.

For help with Zoom: Zoom Help.

UC San Diego Principles of Community

The University of California, San Diego is dedicated to learning, teaching, and serving society through education, research, and public service. Our international reputation for excellence is due in large part to the cooperative and entrepreneurial nature of the UC San Diego community. UC San Diego faculty, staff, and students are encouraged to be creative and are rewarded for individual as well as collaborative achievements.

To foster the best possible working and learning environment, UC San Diego strives to maintain a climate of fairness, cooperation, and professionalism. These principles of community are vital to the success of the University and the well-being of its

constituents. UC San Diego faculty, staff, and students are expected to practice these basic principles as individuals and in groups.

Complete UC San Diego Principles of Community in English and Spanish

UC San Diego Academic Policies

Academic Integrity

Academic Integrity is expected of everyone at UC San Diego. This means that you must be honest, fair, responsible, respectful, and trustworthy in all your actions. Lying, cheating or any other forms of dishonesty will not be tolerated because they undermine learning and the University's ability to certify students' knowledge and abilities. Thus, any attempt to get, or help another get, a grade by cheating, lying, or dishonesty will be reported to the Academic Integrity Office and will result in sanctions. Sanctions can include an F in this class and suspension or dismissal from the University. So, think carefully before you act by asking yourself:

a) is what I'm about to do or submit for credit an honest, fair, respectful, responsible & trustworthy representation of my knowledge and abilities at this time and,
b) would my instructor approve of my action?

You are ultimately the only person responsible for your behavior. So, if you are unsure, don't ask a friend—ask your instructor, instructional assistant, or the Academic Integrity Office. Learn more about academic integrity.

(Source: Academic Integrity Office, 2018)

Classroom Behavior Policy

This is a large class with a lot of people in one room trying to learn and focus. During instruction, please refrain from having side conversations — even quiet ones carry in a lecture hall. There will be frequent breaks for small-group active learning throughout each lecture, and those are great opportunities to get to know the people around you.

A note on questions: I do not take questions during lecture while I am presenting. Instead, during each active learning break, if you have a question, raise your hand and I will come to you directly. You can also post questions on Piazza at any time.

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Discussion Section Attendance

Attendance at your registered discussion section is mandatory on quiz dates. There are four discussion sections; you must attend the one you registered for. There will not be an opportunity to take a quiz in a different section.

If you have circumstances outside of your control or an OSD accommodation that conflicts with your registered section on a quiz date, contact me as early as possible and we will work something out. However, no accommodations will be made for scheduling conflicts with other classes — if you have a time conflict, it is your responsibility to resolve it through your course enrollment, not after the fact.

Religious Accommodation

It is the policy of the university to make reasonable efforts to accommodate students having bona fide religious conflicts with scheduled examinations by providing alternative times or methods to take such examinations. If a student anticipates that a scheduled examination will occur at a time at which his or her religious beliefs prohibit participation in the examination, the student must submit to the instructor a statement describing the nature of the religious conflict and specifying the days and times of conflict.

For final examinations, the statement must be submitted no later than the end of the second week of instruction of the quarter.

For all other examinations, the statement must be submitted to the instructor as soon as possible after a particular examination date is scheduled.

If a conflict with the student's religious beliefs does exist, the instructor will attempt to provide an alternative, equitable examination that does not create undue hardship for the instructor or for the other students in the class.

See: EPC Policies on Religious Accommodation, Final Exams, Midterm Exams

Nondiscrimination and Harassment

The University of California, in accordance with applicable federal and state laws and university policies, does not discriminate on the basis of race, color, national origin, religion, sex, gender, gender identity, gender expression, pregnancy (including pregnancy, childbirth, and medical conditions related to pregnancy or childbirth), physical or mental disability, medical condition, genetic information, ancestry, marital status, age, sexual orientation, citizenship, or service in the uniformed services. The university also prohibits harassment based on these protected categories, including sexual harassment, as well as sexual assault, domestic violence, dating violence, and stalking. The nondiscrimination policy covers admission, access, and treatment in university programs and activities.

If students have questions about student-related nondiscrimination policies or concerns about possible discrimination or harassment, they should contact the Office for the Prevention of Harassment & Discrimination (OPHD) at (858) 534-8298, ophd@ucsd.edu, or make a Report with OPHD.

Campus policies provide for a prompt and effective response to student complaints. This response may include alternative resolution procedures or formal investigation. Students will be informed about complaint resolution options.

A student who chooses not to report may still contact CARE at the Sexual Assault Resource Center for more information, emotional support, individual and group counseling, and/or assistance with obtaining a medical exam. For off-campus support services, a student may contact the Center for Community Solutions. Other confidential resources on campus include Counseling and Psychological Services, Office of the Ombuds, and Student Health Services.

- — 858.534.5793 | sarc@ucsd.edu
- — 858.534.3755

See: Nondiscrimination Policy Statement

SUBJECT TO CHANGE POLICY

Due to unforeseen circumstances, minor aspects of this syllabus may change. This includes changes to scheduling, grading values, and policy. It is the responsibility of the instructor and instructional assistants to announce changes with reasonable notice in multiple formats (e.g., lecture and Canvas announcements, email, etc.). It is the responsibility of the student to make note of these changes and communicate with the instructor if you have questions or concerns about the changes.

Letter of Recommendation Policy

I want you to be able to get a strong letter of recommendation — whether from me or from someone else. A few things to keep in mind:

- A good letter requires that the writer knows you well. You should be more than a name with grades next to it. In a classroom setting, that means having conversations after lecture, coming to office hours, or reaching out to grab coffee and chat. Over multiple quarters, it means maintaining that relationship and mentorship.
- This is an introductory course. On its own, it is unlikely to give me enough evidence to write a compelling letter for something like graduate school, medical school, or other professional programs — unless we develop an extended relationship through additional courses, research together, or your work as a TA or PLA for me.
- That said, I am more than happy to write letters of recommendation for students who are transferring to another university, applying for internships, or pursuing other opportunities typical of first- or second-year students. If you think you might want a letter from me, start building that relationship early.