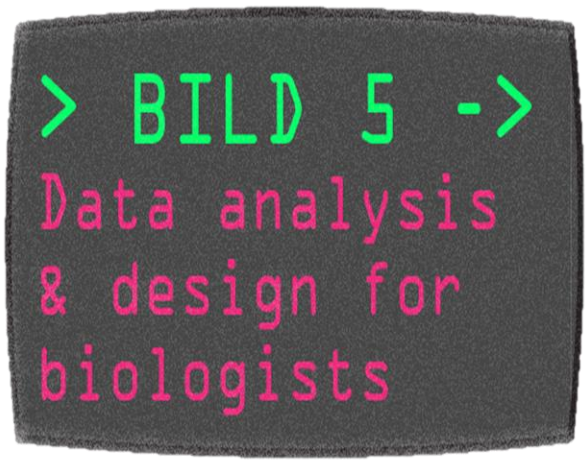

"The great tragedy of Science — the slaying of a beautiful hypothesis by an ugly fact." — Thomas Henry Huxley

"Politicians use statistics in the same way that a drunk uses lamp posts - for support rather than illumination." – Andrew Lang

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. 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.

CONTACT AND SCHEDULING INFO

INSTRUCTOR

Dr. Liam O'Connor Mueller (he/him/his)

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

LECTURE TIME

MWF 2:00-2:50PM SEQUOYAH HALL Room 147

FINAL EXAM TIME

Friday, June 10, 2022; 3-6pm PST (Location TBD)

INSTRUCTIONAL ASSISTANTS AND MEETING TIMES

SECTION MEETING TIMES

Section	Time	Location	IA	IA Contact
A01	4:00-4:50pm	WLH 2110	Michelle Chiew	mhchiew@ucsd.edu
A02	5:00-5:50pm	WLH 2110	Mohnish Alishala	malishal@ucsd.edu

MUELLER OFFICE HOURS

Monday 3:00-4:00pm (in person)

Wednesday 11:00am-1:30pm (On Zoom)

Or by appointment! If you need to schedule office hours outside of the times above, email me you schedule for the week and I will do my best to accommodate you.

PREREQUISITES

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

TEXTBOOK

Spiegelhalter, D. (2019). *The art of statistics: Learning from data*. Penguin UK.

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 to run your Jupyter Notebook and RStudio. 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.

You are allowed to bring your technology into lecture - however it is not necessary. **Section activities are based around R coding, so it is recommended that you bring a laptop to your section if you are able.** If you are unable to bring one, we will be working in small groups during section meetings and so can work with others (however you will ultimately be responsible for turning in your own assignment).

There are resources on campus available if you have tech needs. Please visit: https://libraries.ucsd.edu/computing-and-technology/computers-and-laptop-stations/index.html

CONTACT

The best way to contact me is by email: lomueller@ucsd.edu. On all emails PLEASE put "BILD 5" in the subject line to indicate that the email pertains to this course. If you email about anything regarding your status in the course, please include your UCSD username, and PID. If you have questions about course content, it is often faster to email your IA directly.

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.

LEARNING PHILOSOPHY

This course is designed to be an environment for everyone to learn and construct a shared understanding of the material. **Active participation** by engaging with the lecture material, asking and answering questions, and contributing to breakout sessions during discussion time is expected. Being able to communicate understanding and confusion, is critical to success in any discipline, and is very useful for learning. To encourage collaboration, section activities will be done in groups, and grades will not be assigned on a curve. You will also be required to provide feedback to your peers on certain assignments. Instead of memorization, we will focus on developing an understanding of fundamental concepts as they apply to different examples. Therefore, assignments and assessments will include questions that are based on solving problems in new contexts.

OVERALL COURSE EXPECTATIONS

What you can do to support your success in the course:	**What I will do to support your success in the course:**
Read the syllabus and stay current with course information	Be prepared and bring my enthusiasm for teaching to each session. Provide all materials and course information in the time you need it.
Keep up with lecture, readings, and section assignments, as each one builds on the previous one.	Respond to emails within one working day, and provide timely feedback on assignments / submissions.
Contribute to the learning environment with fairness, cooperation, and professionalism	Establish a learning environment with fairness, cooperation and professionalism, and will take action if these principles are violated.
Treat your classmates, instructional assistants and myself honestly and ethically	Treat you honestly and ethically, and will address any concerns you might have
Commit to excel with integrity. Have the courage to act in ways that are honest, fair, responsible, respectful & trustworthy. Please read UC San Diego's Policy on Integrity of Scholarship and take the integrity pledge!	Uphold integrity standards and create an atmosphere that fosters active learning, creativity, critical thinking, and honest collaboration.

Manage your time, so you can stay on track with the course and complete tasks on time	Only assign work that is vital to the course, and will work to meet the standard credit hour allotment for the course.
Communicate with me if you determine that a deadline cannot be met due to extenuating circumstances	Consider requests for adjustments and will make reasonable exceptions available to all students when approved

A TYPICAL WEEK IN THIS COURSE

WHAT?	**WHERE?**
Going to lecture	In-person and podcast (MWF) The course will be run in person and the podcast recording will be available asynchronously. Attendance is not mandatory but highly recommended!
Section Meetings/Activities	In-person This will NOT be recorded. Section activity may also be done on your own time asynchronously. You will benefit greatly from attending (working with others and the IA), but it is not mandatory.
Office Hours	Some will be in-person and some will be via Zoom (see Canvas for details)

WEEKLY STUDENT DELIVERABLES

All due times are 11:59pm PST	
Wednesday EVERY WEEK	Discussion post #1
Sunday EVERY WEEK	Discussion Post #2,

	Section Activity, **All other deliverables (SEE BELOW)**
Sunday week 1	Extra Credit Survey #1
Sunday week 4	Term Project #1 - Question Due
Sunday week 6	Term Project #2 - Experimental Design
Sunday week 7	Peer Review of Term Project #2
Sunday week 8	Term Project #3 - Analysis Plan
Sunday week 10	Term Project DUE Extra Credit Survey #2
Finals Week	In-person final assessment

COURSE LECTURE SCHEDULE

Week	Day	Date	Lecture Topic
1	M	3/28	Why Science?
1	W	3/30	Why Statistics?
1	F	4/1	Why Programming? - and R and Rstudio intro
2	M	4/4	Describing Data: Types of data
2	W	4/6	Exploratory Data Analysis: What makes a good figure?
2	F	4/8	Exploratory Data Analysis: Different types of figures
3	M	4/11	Describing data: Distributions

3	W	4/13	Describing data: Measures of central tendency and the normal distribution
3	F	4/15	Describing data: Variance and error in the normal distribution
4	M	4/18	Describing Data: Variance and confidence intervals
4	W	4/20	Turning questions into biological and statistical hypotheses
4	F	4/22	Transformations and other distributions **(also last day to drop without a W)**
5	M	4/25	Different types of studies - to manipulate or not
5	W	4/27	Variables and sampling design/ethical considerations
5	F	4/29	Common pitfalls of experimental design
6	M	5/2	Calculating a test statistic - the t test
6	W	5/4	Power, p values, effect size, and sample size
6	F	5/6	P values: the Good, the Bad, and the Ugly **(also last day to drop. W will remain on transcript)**
7	M	5/9	Multiple Comparisons
7	W	5/11	ANOVA and post-hoc testing
7	F	5/13	Pearson Correlation
8	M	5/16	HOLIDAY

8	W	5/18	Linear regression & ordinary least squares
8	F	5/20	Linear regression II
9	M	5/23	Multiple regression and the magic of machine learning
9	W	5/25	Generalized Linear Models & *The Arcsine is Asinine*
9	F	5/27	Open / Catch up
10	M	5/30	Memorial Day
10	W	6/1	Simplifying Multivariate Data
10	F	6/3	The Dark History of Statistics and a Different Way Forward.
Finals	F	6/10	Final Exam 3:00 – 6:00pm

GRADING

Discussion Board Prompts (10 points each; drop lowest 2 scores)	80 points
Section Activities (15 points each and drop lowest score)	135 points
Term Project Checkpoints (10 points each)	30 points

Term Project Peer Review	20 points
Final Term Project	30 points
Final Exam	50 points
TOTAL	**345 points**
Extra Credit Surveys	5 points

Grading Scale

Letter	**% Range**	**Point Cutoff**
A+	100 – 97	334
A	96 - 93	320
A-	92 - 90	310
B+	89 – 87	300
B	86 – 83	286
B-	82 – 80	276
C+	79 – 77	265
C	76 – 73	251
C-	72 – 70	241
D	69 -60	207
F	Below 60	206 or fewer

Grade cut-offs will never be shifted up, but may be shifted down depending on the final overall grade distribution.

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 R code with each other. Copying and pasting code is an everyday tactic. However, your final answers and responses must be your own and written in your own words. There is to be absolutely no sharing of answers to questions about theory. For coding assignments, we will frequently ask for you to annotate your code and explain what your code is doing. Even if you have copied code from someone else, your explanation of that code must be your own. All assignments 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.

DISCUSSION BOARD PROMPTS

Each week there will be a discussion prompt placed in the “Discussions” section of Canvas prior to Monday morning. You must make one substantive response to the prompt before Wednesday @11:59pm. You must respond to another student’s reply by Sunday night at 11:59pm. 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. Your lowest two scores will be dropped.

SECTION ACTIVITIES

Every week there will be an activity with a focus on using R and RStudio to conduct the analysis and visualizations we’ll learn in lecture. It will be in the form of an RMarkdown document and often an associated .csv data file. After completing the activity, you will upload your response as an HTML file. If you don’t know what that means - don’t worry, we’ll explain! If you have a laptop, please bring it to the section meeting, if possible. If you do not attend your section synchronously, then it is your responsibility to complete the assignment on your own time. Everyone will be required to upload their individual response, even though all work done synchronously will be completed in small groups. Your lowest score will be dropped.

FINAL EXAM

You will have 3 hours for the final exam, even though it will not be written to take the entire time. You will not be asked to code on the final. A study guide with relevant topics will be provided beforehand. You may bring 1 sheet of 8.5”x11” paper with information of your choosing on both sides. You can add anything, but it must be of your own creation - we will collect them at the end. It will be in-person and synchronous. **Alternative times will only be for approved reasons that are outside the control of the student and must be scheduled before the day of the final exam.**

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!

EXTRA CREDIT

The 5 points extra credit can be earned by completing course evaluations and related surveys which aim to improve the course and the educational experiences of your future peers. There are no other opportunities for extra credit beyond what is assigned by the course instructor.

LATE ASSIGNMENTS

Assignments must be submitted on time to be eligible for full credit. 1% will be deducted for every hour the assignment is late. Email Dr. Mueller if you need to turn in an assignment late. Late assignments over two weeks late will not be considered unless a prior arrangement with Dr. Mueller has been agreed upon.

TECHNICAL SUPPORT

First, check the list of video help guides on Canvas to see if your question is addressed. For help with using RStudio or Jupyter Notebooks, please contact your Instructional Assistant.

For help with accounts, network, and technical issues:
https://acms.ucsd.edu/contact/index.html

For help connecting to electronic library resources such as eReserves and e-journals:

https://library.ucsd.edu/computing-and-technology/connect-from-off-campus/

Campus Policies

- UC San Diego Principles of Community
- UC San Diego Policy on Integrity of Scholarship
- **Religious Accommodation**
- **Nondiscrimination and Harassment**
- **UC San Diego Student Conduct Code**

Diversity and equity statement

It is important for us to make sure that how we teach this course and how we accommodate different student needs reflects the differences of race, ability, sexual orientation, age, and gender identity that enrich our classroom experience and campus. If you have any concerns related to diversity and equity in the course, please contact the instructor.

If you find yourself in an uncomfortable situation, ask for help. The university is committed to upholding policies regarding nondiscrimination, sexual violence, and sexual harassment.

Student Resources

Learning and Academic Support	
Ask a Librarian: Library Support *Chat or make an appointment with a librarian to focus on your research needs*	**Writing Hub Services in the Teaching + Learning Commons** *One-on-one online writing tutoring and workshops on key writing topics*
Course Reserves, Connecting from Off-Campus and Research Support *Find supplemental course materials*	**Supplemental Instruction** *Peer-assisted study sessions through the Academic Achievement Hub to improve success in historically challenging courses*
First Gen Student Success Coaching Program *Peer mentor program that provides students with information, resources, and support in meeting their goals*	**Tutoring – Content** *Drop-in and online tutoring through the Academic Achievement Hub*

Office of Academic Support & Instructional Services (OASIS) *Intellectual and personal development support*	**Tutoring – Learning Strategies** *Address learning challenges with a metacognitive approach*

Support for Well-being and Inclusion

Basic Needs at UCSD
Any student who has difficulty accessing sufficient food to eat every day, or who lacks a safe and stable place to live is encouraged to contact: foodpantry@.ucsd.edu
basicneeds@ucsd.edu
(858) 246-2632

Counseling and Psychological Services
Confidential counseling and consultations for psychiatric service and mental health programming

Triton Concern Line
Report students of concern: (858) 246-1111

Office for Students with Disabilities (OSD)
Supports students with disabilities and accessibility across campus

Community and Resource Centers
Office of Equity, Diversity, and Inclusion *As part of the Office of Equity, Diversity, and Inclusion the campus community centers provide programs and resources for students and contribute toward the evolution of a socially just campus*

diversity@ucsd.edu

(858) 822-3542

Get Involved
Student organizations, clubs, service opportunities, and many other ways to connect with others on campus

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

Campus Safety

Keeping our campus healthy takes all of us. You are expected to follow the campus safety requirements and pursue personal protection practices to protect yourself and the others around you. These include:

Participate in the university's daily screening process.
Everyone must complete a Daily Symptom Survey to access a university-controlled facility.
Participate in the university's testing program.
All students are required to participate in the COVID-19 Testing program as required by their vaccination status:

- Unvaccinated students with approved exceptions must complete a COVID-19 test twice a week.
- If you are a student residing in campus-operated housing, you must complete a COVID-19 PCR test no more than 24 hours after returning for spring quarter as well as on Day 5
- All undergraduate and graduate students have access to free symptomatic and asymptomatic COVID-19 testing through Student Health Services or UC San Diego Health, including tests in vending machines distributed across campus.

General Guidelines for Masking Outdoors

Effective March 21, masking is optional for all students, faculty and staff while outdoors on campus. Attendees at outdoor campus events must wear a face mask if required by the event organizer. Vaccinated students and campus employees who have been exposed to the SARS-CoV-2 virus must also mask outdoors.

General Guidelines for Masking Indoors

Effective March 21, masking will be optional except that it will remain required in all indoor classroom/instructional settings, clinical areas, and on Triton/university transportation until further notice. We encourage anyone who feels more comfortable continuing to wear a mask to do so, as masking remains one of the easiest and most effective ways to reduce the spread of the virus.

Monitor the daily potential exposure report.
Every day the university will update the potential exposure report with building and some classroom information and the dates of exposure. Download the CA COVID Notify app to your phone to receive an alert if you have been potentially exposed to COVID-19.
Assist in the contact tracing process.
If you're contacted by a case investigator, it means you have been identified as close

contact, please respond promptly. You must assist with identifying other individuals who might have some degree of risk due to close contact with individuals who have been diagnosed with COVID-19.

Contact the instructional team if you are impacted by COVID-19

Please note that due to the ongoing COVID-19 Pandemic, changes may be made in response to new developments and information.

Privacy Practices in This Course

This course is a community built on trust; as a learning community, we are collectively responsible for upholding privacy protections. In order to create a community built on trust and the most effective learning experience, our interactions, discussions, and course activities must remain private and free from external intrusion. We have obligations to each other to preserve privacy and cultivate fearless inquiry. We respect the individual dignity of all and will refrain from actions that diminish others' ability to learn.

As your instructor, I am committed to protecting your privacy by only using university-approved course technologies and adhering to the Family Educational Rights and Privacy Act (FERPA):

https://catalog.ucsd.edu/about/policies/notification-of-rights/index.html.

and Campus Privacy Office guidelines. This includes using your educational data only as allowed by FERPA, for example, for legitimate educational purposes such as submitting your final grades to the registrar's office.

Please note the following privacy practices for our course:

Course platform.

This course uses Canvas, Zoom, and Gradescope, which collects information about your engagement with course materials. I will review this information periodically to ensure

students are engaged and look for signs of students falling behind. I will also review this information in case of academic misconduct allegations, if relevant.

Online/video classes.

Regarding video-conferencing, while I ask, to the extent you are comfortable and able, that you keep your videos on during online confrences to aid in the development of our learning community, I also understand that may not always be possible. Know that you will not be penalized for choosing to disable your video during Zoom sessions. You are welcome to use an appropriate virtual background if you do not want to have your surroundings visible. Be mindful of others who may not wish to be visible or recorded in the background.

Using learning materials.

Course materials (videos, assignments, problem sets, etc.) are for use in this course only. You may not upload them to external sites, share with students outside of this course, or post them for public commentary without my written permission. We will not pin or take screenshots of fellow classmates or record sessions during synchronous online sessions or share discussion thread posts from the learning management system unless granted explicit permission to do so. Unauthorized sharing or uploading to exam questions, test answers, or summaries of exams is prohibited.

Using live class recordings.

We are recording class meetings to support remote students and to provide everyone in the class with useful study aids. These recordings will be available for review through our learning management system. Students are prohibited from recording the class themselves unless a student has an approved academic accommodation for such recording. The university strictly prohibits anyone from duplicating, downloading, or sharing live class recordings with anyone outside of this course, for any reason.

Sharing student information.

You may work on group projects with other students or be asked to review or respond to their work. Other materials and activities may provoke debate, argument, or spirited discussion; some of us may volunteer sensitive personal information. Do not share others' personal information, including class dialogue or performance, on sensitive topics outside of our course community. Student work, discussion posts, and all other forms of student information related to this course should be handled with respect and

remain within interactions of this course. You may publicly post your own work, provided it does not violate academic dishonesty policies or show responses to assessments; public posting of group work requires consent from all group members. Research conducted as part of a class is subject to UC research policies and may include sensitive information. Students may not share research information without permission from the instructor.

Sharing course information with others.

Do not post images or identifiable conversations that occur in class to social media or to those beyond our learning community. Sharing private information about our course community (including discussions, activities, presentations, student work, etc.) with others for the purpose of inviting external attention, intrusion, ridicule, or harassment is an egregious breach of trust.

If you have concerns after reviewing these privacy statements, I invite you to reach out to the instructor.

This Document is Subject to Change

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.

"I read part of it all the way through."
-Samuel Goldwyn (Probably)