

Syllabus

Course Information

Course Number: BIOL683
Course Title: Experimental Design in Biology
Time: MW 4:00-5:15
Location: HELD 200
Credit Hours: 3

Instructor Details

Instructor: Dr. Heath Blackmon
Office: BSBW 425
E-Mail: blackmon@tamu.edu
Office Hours: By appointment

Course Description

This course is intended to provide a foundation in the proper design of scientific research projects in the life sciences. A wide range of experimental results will be covered, and the focus will be on learning to choose and implement appropriate analyses in a reproducible framework. All work will be completed in the R environment.

Course Prerequisites

None

Special Course Designation

Qualifies as a quantitative elective in the EEB IDP. It also qualifies under the computational genetics requirement and the statistics and bioinformatics category for the Genetics IDP. This course can also be used as part of the graduate bioinformatics certificate program.

Course Learning Outcomes

Design biological studies that are statistically tractable.
Perform data visualization and exploration in R.
Perform reproducible statistical analyses using the programming language R.
Produce publication quality plots using R.

Textbook and/or Resource Materials

No textbooks are required but if you have a weak background good references would be:

Grading Policy

A total of 300 points are available in the course: 5 worksheet assignments (20 points each), two exams (100 points each). The breakdown of grades will be:

A = 90%-100%

B = 80%-90%

C = 70%-80%

D = 60%-70%

F = 0-60%

Late Work Policy

No late work will be accepted after the due date provided. Work submitted by a student as makeup work for an excused absence is not considered late work and is exempted from the late work policy. (See Student Rule 7.). Seven worksheets will be assigned and the lowest two will be dropped from your grade.

Course Plan

1. Introduction:

- Lecture: Why take this course?
- Lecture: Effective use of AI
- **Worksheet 1: Who are you and why are you here**

2. Basic R:

- Live Coding: Basic R (syntax, data types)
- Live Coding: Data management and cleaning
- **Worksheet 2: Basics of R**

3. Exploratory Data Analysis:

- Lecture: Descriptive statistics, data visualization
- Live Coding: Creating plots and summarizing data in R

4. Probability and Simulation:

- Lecture: Probability, distributions, and inference
- Live Coding: Simulating and analyzing distributions in R
- **Worksheet 3: Probability and distributions**

5. Hypothesis Testing:

- Lecture: Hypothesis testing
- Live Coding: Performing tests
- **Worksheet 4: Choosing appropriate tests**

6. Test week 1

- Review
- **Test**

7. Regression Analysis:

- Lecture: Linear regression and model diagnostics
- Live Coding: Fitting and diagnosing regression models in R

- **Worksheet 5: Interpreting models and results**
- 8. Generalized Linear Models and Mixed Models:**
 - Lecture: Introduction to GLMs and mixed models
 - Live Coding: Implementing GLMs and mixed models in R
 - **Worksheet 6: Developing models in R**
- 9. Model Selection:**
 - Lecture: Model selection
 - Live Coding: Applying model selection techniques in R
- 10. Dimensional Reduction:**
 - Lecture: PCA
 - Live Coding: PCA
- 11. Advanced Topics and Applications:**
 - Lecture: Bayesian methods and MCMCs
 - Live Coding: Diagnosing MCMCs
 - **Worksheet 7: Are we there yet**
- 12. Test week 2**
 - Review
 - **Test**

Technology

Students will need a laptop capable of installing and running R and Rstudio.

Course website

Additional material will be provided on the course website: <http://coleoguy.github.io/expdes>

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](#) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to [Student Rule 7](#) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor” ([Student Rule 7, Section 7.4.1](#)).

“The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence” ([Student Rule 7, Section 7.4.2](#)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](#).)

Academic Integrity Statement and Policy

“An Aggie does not lie, cheat or steal, or tolerate those who do.”

“Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one’s work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case” ([Section 20.1.2.3, Student Rule 20](#)).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

***NOTE:** Faculty associated with the main campus in College Station should use this Academic Integrity Statement and Policy. Faculty not on the main campus should use the appropriate language and location at their site.*

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

***NOTE:** Faculty associated with the main campus in College Station should use this Americans with Disabilities Act Policy statement. Faculty not on the main campus should use the appropriate language and location at their site.*

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based

discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see [University Rule 08.01.01.M1](#)):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University’s goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with [Counseling and Psychological Services \(CAPS\)](#).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University’s [Title IX webpage](#).

***NOTE:** Faculty associated with the main campus in College Station should use this Title IX and Statement on Limits of Liability. Faculty not on the main campus should use the appropriate language and location at their site.*

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student’s academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

COVID-19

Campus Safety Measures

To help protect Aggieland and stop the spread of COVID-19, Texas A&M University urges students to be vaccinated and to wear masks in classrooms and all other academic facilities on

campus, including labs. Doing so exemplifies the Aggie Core Values of respect, leadership, integrity, and selfless service by putting community concerns above individual preferences. COVID-19 vaccines and masking — regardless of vaccination status — have been shown to be safe and effective at reducing spread to others, infection, hospitalization, and death.