Experiments in Ecology and Agriculture
ENY 6934, Spring 2021, 3 credit
Time and location: T/R from 1:55pm-3:30pm, 100% online
Zoom:
https://ufl.zoom.us/j/99473025939?pwd=TGZlOWs5Q2g5NFJVMXQyQ3ovUkF6Zz09
passcode: ecology

Instructor: Phil Hahn, **office:** Steinmetz 2109, **phone:** (352) 273-3960, **email:** hahnp@ufl.edu
Office Hours: After class (3:30-4pm) or by appointment (email to arrange a time) in my office or Zoom.

TA: Leo Ohyama, **email:** leo.ohyama@ufl.edu, **office hours:** by appointment

Meetings: Meetings in Spring 2021 will be 100% online for all students, including Gainesville, REC, and remote students. See above for zoom link.

Course description: This applied research methods and analysis course addresses common challenges of biological data, such as dealing with nested experimental designs, repeated measurements, and non-normal distributions. The course focuses on proper data management, posing hypotheses and constructing appropriate statistical models to test them in R, biological interpretation of the statistical results, and effective data visualization. Each week the instructor will give two short lectures (~20-30 minutes). Lectures will cover foundational concepts, some statistical theory, and will introduce R code. We will also occasionally discuss relevant readings. Remaining class time will be spent editing, writing, and executing R code. Example data and R code will be available on Canvas.

Prerequisites and Expectations: STA 6093 or equivalent is required. A basic understanding of R/RStudio is required. If you need to review basic R skills, please watch the video on Canvas under the Module "Introductory materials and resources."

Learning outcomes:
By the end of the course, students will be able to:
- Propose biological questions and formulate hypotheses to test them.
- construct appropriate (and creative) statistical models that are commonly used in entomological studies using freely available packages in R.
- analyze, visualize, interpret, and report the results of statistical models using formats acceptable for publication.
- critique results of analyses reported by peers and in the literature.
- locate R documentation and use new R packages and functions.

Textbooks (recommended):
- *Experimental Design and Analysis for Biologists.* Quinn, G.P. and Keough, M.J. (2002) Cambridge Press.
- *Mixed effect models and extensions in Ecology with R.* Zuur, A.F. et al. (2009) Springer.
- *The R Book.* Crawley, M.J. (2012) Second Edition. Wiley.

- *R for Data Science*. Grolemund, G. and H. Wickham. (2017) free online: https://r4ds.had.co.nz/
- *How to do ecology.* Karban, R., Huntzinger, M. and Pearse, I. (2017) Princeton Press.

Readings (numbered by discussion week)

2. Weissgerber et al. (2017) Data visualization, bar naked: A free tool for creating interactive graphics. J. Biol. Chem. 292:20592-20598.

3. Borer, E.T. et al. (2009) Some simple guidelines for effective data management. Bulletin of the Ecological Society of America. April 2009 205-214.

4. Zuur et al. (2010) A protocol for data exploration to avoid common statistical problems. Methods in Ecology and Evolution 1:3-14.

5. Karban et al. (2017). How to do Ecology. Chapter 1-2.

6. Karban et al. (2017). How to do Ecology. Chapter 3-4.

7. Hurlbert, S.H. (1984) Pseudoreplication and the design of the ecological field experiments. Ecological Monographs 54:187-211.

8. Harrison et al. (2018) A brief introduction to mixed effects modelling and multi-model inference in ecology. PeerJ 6:e4794.

9. Gelman, A. and Loken, E. (2014) The statistical crisis in science. Data-dependent analysis--a "garden of forking paths"-- explains why many statistically significant comparisons don't hold up. American Scientist 102:460-465.

10. Bolker et al. (2008) Generalized linear mixed models: a practical guide for ecology and evolution. Trends in Ecology and Evolution 24: 127-135.

Materials (freely available online):

- R software: available for free download at r-project.org
- R Studio: helpful alternative to the default R graphical user interface (GUI)
- Tidyverse: a collection of user-friendly R packages designed for data science that share an underlying design philosophy, grammar, and data structures.

Assessments

Participation: Students are expected to attend class, actively participate in discussions, breakout groups, and class activities. Synchronous participation via zoom includes verbal discussions, chat-based questions/comments, and interaction within breakout groups.

Lead discussion: Most weeks there will be a weekly discussion reading. Students will sign up in groups (2-3 students per group) to lead one discussion (~30 minutes). A rubric will be posted on Canvas describing how these discussions will be assessed.

R challenges: Most weeks we will have a problem to complete in R (10 challenges worth 10 points each). We will begin these problems in class working in groups and students will post their results on Canvas by the end of the week.

Quizzes: There will be 4 online quizzes (25 points each) based on the lecture material and readings over the course of the semester. Quizzes will focus on writing R code, interpretation of data, and statistical results. There will be no quizzes during weeks that homework assignments are due. Expect to spend 1-2 hours on each quiz.

Homework assignments: Students will complete 2 written homework assignments (50 points each). The homework will include five components (~2 pages of text, plus figures/tables):

1) *Hypotheses and experimental design* - State your hypotheses and briefly describe the experimental design.

2) *Data Analysis* section - a description of your data (response variables and predictor variables), your statistical models used to test the hypotheses, and any R packages you used beyond base R.

3) *Results* section - a description of your results describing the significant results, general trends of the data, and effect sizes. Include statistics (F-values, χ^2, model fit, p-values, etc.) and cite tables and figures when appropriate.

4) *Interpretation* section - ~1 paragraph interpreting the biological significance of the results. You should also (briefly) reiterate the main question and importance. This section should be similar to the first paragraph of a discussion section.

5) *Figures and tables* section - Include appropriate figures and tables. The figures and tables should be reasonably formatted, but not necessarily publication quality.

Final project: Students will submit a project proposal (50 points) and completed project (100 points). The final project will allow students to dig deeper into a topic covered in class or explore topics not covered in class (e.g., SEM, multivariate analysis, non-linear regression).The project will based on the a formal analysis of real data (i.e., data from your thesis or other agreed-upon data that needs to be analyzed, or data sets provided to students who don't have their own data). The project will take the form of a homework assignment but will require a full methods section that describes the experimental design and data collection, formatted tables, and graphics.

Grade Breakdown

Category	Points
Participation	100
Lead discussion	50
R Challenges	100 (10 challenges, 10 pts each)
Quizzes	100 (4 quizzes, 25 pts each)
Homework assignments	100 (2 assignments, 50 pts each)
Project proposal	50
Project	100
Total	**600**

Grade	Percentage	Minimum points
A	90-100	540
B	80-89.9	480
C	70-79.9	420
D	60-69.9	360
E	<60	<360

Course Timetable

Date	Module	Topic	Recommended Readings	Discussion Topic/Paper	Assignment
Jan 12	1	Data visualization and linear models I: Continuous variables, graphing scatterplots	G&W-3		
Jan 19	1	Data visualization and linear models II: Categorical variables, graphing bar plots and box plots	G&W-3	Weissgerber et al. 2017	Quiz 1
Jan 26	2	Data management and metadata	Q&K-2, G&W-5	Borer et al. 2009	
Feb 2	2	Data exploration		Zuur et al. 2010	Quiz 2
Feb 9	3	Posing questions and hypotheses		Karban 1-2	
Feb 16	4	Research design basics, fixed vs. random effects	Q&K-10, Z-5	Karban 3-4	Quiz 3
Feb 23 (recharge Feb 25)	4	Advanced research designs, split-plot, repeated measures	Q&K-11	Hurlbert et al. 1984	Begin HW 1
Mar 2	4	Covariates	Q&K-12	Harrison et al. 2018	Begin project
Mar 9	4	Contrasts	Q&K-12	Harrison et al. 2018	HW 1 due
Mar 16	5	Generalized linear models, count data	Q&K-13	Gelman & Loken 2014	Begin HW 2; Proposal due
Mar 23	5	Proportions, choice, and survival	Q&K-13	Wasserstein & Lazar 2016	Project check in
Mar 30	6	Generalized linear mixed models			HW 2 due
Apr 6	6	GLMMs (con't), overdispersion	Z-13		Quiz 4
Apr 13	6	GLMMs (con't), contrasts			
Apr 20		Catch up and review			
Mar 16 – Apr 20		Independent project			Project due

Quizzes, homework assignments, and proposal will be due by the end of the listed week (Friday at 11:59pm).

Challenges will need to be posted on Canvas by the end of the week (Friday at 5pm EST).

Project will be due by April 25th at 5pm EST.

Recommended reading codes: G&W = Grolemond and Wickham (2017) R for Data Science; Q&K = Quinn and Keough (2002) textbook; Z = Zuur et al. (2009) textbook.

Grades and Grade Points: For information on current UF policies for assigning grade points, see https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

Online Course Evaluation Process: Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. These evaluations are conducted online at https://evaluations.ufl.edu. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results.

Academic Honesty: As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity." You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

Online recording policy: Our class sessions will be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Software Use: All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Statement of diversity, equity, and inclusion: It is my goal that students from diverse backgrounds, as well as differences in learning styles and personality, will be welcomed and well

served in this course. My definition of diversity includes race, ethnicity, gender, sexual orientation, physical ability, cultural, academic or economic background. I plan to present the material in such a way that it is accessible and relatable to all students. I encourage you to contact me if you have suggestions for how I can improve upon this goal. It is also expected that students will treat each other with respect and no harassment of any kind will be allowed. To report harassment, inappropriate behavior, or discuss issues with a neutral party, please contact the UF RESPECT Team.

Services for Students with Disabilities: The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation 0001 Reid Hall, 352-392-8565, https://disability.ufl.edu/

Campus Helping Resources: Students experiencing crises or personal problems that interfere with their general wellbeing are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.
  • University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu Counseling Services Groups and Workshops Outreach and Consultation Self-Help Library Wellness Coaching
  • U Matter We Care, www.umatter.ufl.edu/
  • Career Connections Center, First Floor JWRU, 392-1601, https://career.ufl.edu/.

Student Feedback and Complaints:
I am always interested to hear feedback from students on how to improve this course. The goal, overall, is for students to get as much out of this course as possible. Please contact me with any thoughts or comments you have that might improve the course. When possible, I will incorporate this feedback immediately. Other times, changes may be implemented to improve future versions of this course. To register formal complaints, please refer to the following:
• Residential Course: https://sccr.dso.ufl.edu/policies/student-honor-code-studentconduct-code/
• Online Course: http://www.distance.ufl.edu/student-complaint-process