Course Number and Title

ZOO6927/ZOO4926-Fall2023: Special Topics, Statistical Ecology

Catalog Description

This is an advanced undergraduate and graduate level course in statistical ecology and evolution methods and concepts. The course focuses on learning the fundamentals of probability distributions as models of animal abundance, models of demographic processes and evolutionary dynamics.

Rationale and placement in the curriculum

This course covers methods and topics that are essential for graduate students pursuing research and careers in ecology, evolution, genetics and related fields. The course has a lab component in which students gain experience using the methods and applying them to their own research. This course complements several other courses on statistics for graduate students in the life sciences, including "Data Analysis in the Natural Sciences" and "Introduction to Bayesian Statistics in the Life Sciences". Statistical Ecology differs from the other statistics courses already offered in the life sciences by focusing on the mathematical statistics theory underlying the methods used in ecological and evolutionary analyses, and in having a dedicated lab section that allows extensive hands-on use of methods. Data Analysis in the Natural Sciences, for example, is focused, as its name suggests, on a general overview of how to tackle a first data analysis and visualization without the student having to know the mathematics of why and how the statistical analyses are done, while "Introduction to Bayesian Statistics" focuses on Bayesian methods for which it is required that students be familiar with "likelihood functions" as sampling models in ecology and evolution. Other courses focus on multivariate statistics methods. This course prepares graduate students in the natural sciences to take more advanced computer intensive courses in statistics and take courses that dwell in depth into multivariate statistics, time series analyses and sampling methods. The course is also unique in its focus on exploring the biologically relevant relationships between most known probability distributions as stochastic models of ecological, genetic and evolutionary processes. It covers topics that are not taught in a typical math/stats two semester course, as well as topics in ecology, genetics and evolution that are outside the scope of any other course taught at UF.

Credit Hours

3 credit hours

Pre-requisites and Co-requisites

MAC2312 & STA2023

(Calculus II or its equivalent) & (Intro to statistics I or its equivalent)

STA4321 is highly desirable but NOT required

MAS4105 is highly desirable but NOT required

Course Objectives

- Explain and apply basic and fundamental concepts of probability and statistical inference in Ecology, Evolution and Genetics.

- Use basic probability distributions to model and think about ecological, genetic and evolutionary processes. Thus, I would like the students to restate scientific arguments in these fields of biology using statistical argumentation.
- Employ basic elements of statistical inference in Ecology, Genetics and Evolution by means of mathematical statistics results. Demonstrate correct usage of these results through extensive paper and pencil homework.
- Identify future course work directions in statistics and encourage students to pursue graduate training in statistics.

Instructor Information

Name: José Miguel Ponciano
Office location: Carr Hall 309
Telephone: (352)-392-2784
E-mail address: josemi@ufl.edu
Web site: http://people.biology.ufl.edu/josemi/
Office hours: by appointment, Carr 309 or Friday mornings between 9:30-12:00

Course Meeting Time(s)

M,W,F | Period 7 (12:50-1:40)

Course Meeting Location(s)

- Lectures M,W,F BAR 211 for Face-to-face

Delivery model:

Face-to-face

Recommended Materials

Textbooks or Other Readings (Not required)

Rice 1995. Mathematical Statistics.

Pielou, E.C. 1969. An introduction to mathematical ecology

Boswell, M.T., Ord, J.K. and G.P. Patil. 1979. Chance mechanisms underlying univariate distributions. In "Statistical Distributions in Ecological Work", pp 3-156. International Cooperative Publishing House.

Ewens, W. 2004. Mathematical Population Genetics 1- Theoretical Introduction. Springer Verlag.

Readings

Required: Additional required readings from the scientific literature will be posted on Canvas.

Course Website

Course materials and related information will be posted on the course E-Learning website at http://lss.at.ufl.edu. You are responsible for all announcements made in class and/or posted on the course website for this course.

Software (Required)

R, freely distributed at http://www.r-project.org

Course Outline (topics covered by week or by class period)

Week	Topic
1	Probability review/ Reading assignment : Essay about statistics in ecology
2	Probability review
3	Discrete probability distributions through practical applications, part I: a Mark-recapture example to introduce Maximum Likelihood (The binomial and hyper-geometric distributions)
4	Discrete probability distributions through practical applications, part II: Animal abundance models and the conditions under which the Poisson distribution arises
5	Continuous distributions through practical examples, part I: The likelihood function for continuous probability models. Waiting times until a demographic event, mutation events, speciation and extinction (births, deaths, density dependence). The Gamma integral in Ecology and Evolution
6	Discrete probability distributions through practical examples, part III: Heterogeneity in Ecology (The Negative Binomial Model). Probability Generating Functions and how to specify your own abundance probability distribution model. Geometric, log-series and compound distributions using randomly stopped sums as population dynamics models.
7	Discrete probability distributions IV: The Multinomial distribution and reduced-parameter multinomial distribution as a general inference tool in ecology and evolution: mark-recapture models, population genetics and Hardy-Weinberg and Phylogenetic inference. Likelihood Ratio Goodness of fit tests
8	Maximum Likelihood inference theory, part I (Fisher's information, Wilks and Wald's theorems)
9	Maximum Likelihood inference part II (Profile Likelihood and Likelihood Ratio Tests) and classical tests as Likelihood Ratio Tests: a review of classic tests like ANOVA with a focus on likelihood ratios
10	Maximum Likelihood inference III and Computer intensive methods (The Delta method and Parametric Bootstrap)
11	Maximum Likelihood inference IV: Population Genetics: the Wright-Fisher model and the coalescent process. Ewens Sampling Formula and Sufficient Statistics.
12	Computer intensive methods: What is MCMC?
13	An introduction to Bayesian Statistics topics.
14	Computer intensive methods: ML inference through Data Cloning
15	Presentation on projects

University policy and resources

College Policy on Zoom Presence

University policy gives students the right to opt out of audio and video participation in classroom Zoom sessions that are being recorded. Also, in non-recorded classroom Zoom sessions, it is best practice not to require students to have their camera and audio on, since

they may face a number of challenges – technical or otherwise – that make this kind of participation difficult or undesirable. For this reason, instructors should consider allowing alternative forms of participation, such as chat and blog entries or, when necessary, audio-only presence. In the rare case where an instructor deems both audio and video participation to be necessary (as in foreign language classrooms), this must be approved by the unit chair/director and by the college, and this requirement must be explicitly disclosed in the course syllabus.

A NOTE ON OUR HYFLEX CLASS THIS SEMESTER

This course consists of two sections, an online and a face-to-face, which are *simultaneous*, i.e., they occur at the same meeting days and times. This means that some students in our class, and the instructor, will be participating from the assigned classroom, while others will be participating remotely (e.g., via Zoom) from their preferred location.

As this is a new format for us, we want to ensure that you are aware of the following:

- This course has been assigned a physical classroom with enough capacity to maintain physical distancing (6 feet between individuals) requirements. Please utilize designated seats and maintain appropriate spacing between students. Please do not move desks or stations. Since our rooms hold significantly fewer students than normal, the number of students *in* the classroom will be quite small – in this section, there will be 8 students in person, with the remaining 17 participating online.
- Students who have signed up for the *in-person* section are expected to attend class on every scheduled meeting day and time, as indicated in the course syllabus. Likewise, students who signed up for the *online* section are expected to attend class virtually on every scheduled meeting day and time, as indicated in the course syllabus.
- In-person students (and faculty) are required to wear approved face coverings at all times during class and within buildings, and to maintain physical distancing of at least six feet at all times. Following and enforcing these policies and requirements are all of our responsibility. Failure to do so will lead to a report to the Office of Student Conduct and Conflict Resolution.
- Face-to-face students and instructors are expected to clean their spaces (desks, chairs, podium) at the end of every class period. Sanitizing supplies are available in the classroom.
- Technology in the classrooms has been updated, but is still insufficient to allow communication between face-to-face and virtual students. The instructor will be the only one able to communicate with both populations, but will have to do so while remaining behind the podium (due to microphone placement). The instructor will have to repeat any questions or comments from face-to-face students for the benefit of the virtual students.
- If face-to-face students wish to join the Zoom call from the classroom, they will have to provide their own computers and, crucially, headsets, in order to avoid interference from the various microphones.
- Instructors will make every effort to incorporate both cohorts of students simultaneously, although this will require a lot of trial and error and a great deal of patience on all our parts.

This will be a different experience for all of us, but we are doing our best to comply with university mandates while still fulfilling the goals and objectives of our courses and providing you with the best possible educational experience. We appreciate your understanding.

Grading

- Bi-weekly Homework and weekly quizzes: 75% of final grade)
- Final Exam (project presentation): 20% of final grade
- Class Participation: 5 % of final grade

Grading Scale

Point Range (%)	Letter Grade	GPA equivalent
≥ 90.00	A	4.0
86.7 – 89.9	A-	3.67
83.3 – 86.6	B+	3.33
80.0 – 83.2	B	3.0
76.7 – 79.9	B-	2.67
73.3 – 76.6	C+	2.33
70.0 – 73.2	C	2.0
66.7 – 69.9	C-	1.67
63.3 – 66.6	D+	1.33
60.0 – 36.2	D	1.0
56.7 – 59.9	D-	0.67
< 56.7	E	0

Note that a "C-" will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html

Grade Curve Policy

No grading curve

Attendance and make-ups

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

If you are experiencing COVID-19 symptoms (click here for guidance from the CDC on symptoms of coronavirus), please use the UF Health screening system and follow the instructions on whether you are able to attend class. Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms. Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. Refer to the above link for more information on the university's attendance policy.

Accommodations
Students who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluations
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at gatorevals.aa.ufl.edu/public-results/.

Academic Integrity
"UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students 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." The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honorcode/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.
Each student is responsible for reviewing and adhering to the UF Student Honor Code: https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/. If you witness any instances of academic dishonesty, please notify your instructor, TA, or the Dean of Students Office (352-392-1261). **I encourage students to work together and to help one another master the material.** You can collect data together, help each other in the field, discuss ideas, practice presentations in front of one another, make up practice exams, critique drafts of each other's reports, etc. Despite this "group learning", the final product that you turn in for grading must reflect your own work. Any contribution from another individual must be credited (e.g., include an acknowledgement section that says "I thank person X and person Y for their helpful comments on a previous draft, and person Z for providing insights about differential equations.").

Resources Available to Students
Health and Wellness

- *U Matter, We Car*e: umatter@ufl.edu; 392-1575. Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at

352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

- *Counseling and Wellness Center*: http://www.counseling.ufl.edu/cwc/Default.aspx; 392-1575
- *Sexual Assault Recovery Services (SARS)*: Student Health Care Center; 392-1161
- *University Police Department*: http://www.police.ufl.edu/; 392-1111 (911 for emergencies)

Academic Resources

- *E-learning technical support*: Learningsupport@ufl.edu; https://lss.at.ufl.edu/help.shtml; 352-392-4357 (opt. 2)
- *Career Resource Center*: Reitz Union; http://www.crc.ufl.edu/; 392-1601
- Library Support: http://cms.uflib.ufl.edu/ask
- Teaching Center: Broward Hall; 392-2010 or 392-6420
- Writing Studio: 302 Tigert Hall; http://writing.ufl.edu/writing-studio/; 846-1138
- **Accommodations for Students with Disabilities**
    - Students who require accommodations for a disability must contact the UF Disability Resource Center (https://www.dso.ufl.edu/drc) to request an Accommodation Letter. No accommodations are available to students until the letter is provided to the instructor. Once your instructor receives your letter, your instructor and TA will be happy to work with you to arrange the necessary accommodations.

Procedure for Conflict Resolution

Any classroom issues, disagreements or grade disputes should be discussed first between the instructor and the student. If the problem cannot be resolved, please contact the (Under)Graduate Coordinator or the Department Chair. Be prepared to provide documentation of the problem, as well as all graded materials for the semester. Issues that cannot be resolved departmentally will be referred to the University Ombuds Office (http://www.ombuds.ufl.edu; 392-1308) or the Dean of Students Office (http://www.dso.ufl.edu; 392-1261). For further information refer to https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf (for residential classes) or http://www.distance.ufl.edu/student-complaintprocess (for online classes).

Software use

All faculty, staff and student of the University are required and expected to obey 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.