Course Number and Title

ZOO6927/4926-Fall2016: Statistical Principles for the Biological Sciences

Catalog Description

The aim of the course is to acquaint senior undergraduates and graduate students in the natural sciences with fundamental principles of statistical inference, and provide the foundation for statistical learning in life sciences graduate school. I will share my vision of statistics and stochastic processes as a great language to translate fundamental questions in biology into testable hypotheses and models that can be confronted with data. I will present basic probability distributions as stochastic models of ecological and genetic processes and fundamental concepts of maximum likelihood inference, Bayesian statistics and computer intensive techniques. The class will be taught using regular lectures on M, W and F, period 6 and with an additional help session on Friday during period 7. The course will begin with a short review of basic probability concepts and an introduction to R. *A note on software:* The course DOES NOT focus on learning R, but rather, on providing the statistical foundation to students needing to program statistical solutions for their own biological questions. In that sense, R learning in this course does not come by repeating instructions but rather, by doing.

Credit Hours

3 credit hours

Pre-requisites and Co-requisites

A basic statistics course and at least one calculus course is required. A basic probability course and a linear algebra course are also highly desirable, but not required.

Course Objectives

By the end of the course, the student will be expected to:

- Understand basic and fundamental concepts of probability and statistical inference in science, with particular applications to the Biology
- Write clean, simple and functional R code to carry a basic data exploration and analysis
- How to use basic probability distributions to model relevant ecological and genetic processes and test scientific hypotheses using these stochastic models
- Understand the basic elements of mathematical statistics
- Identify future course work directions in Statistics

Instructor Information

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Web site: http://people.biology.ufl.edu/josemi/
Office hours: by appointment, Carr 309 or Friday afternoon 3:00-5:00 PM

Course Meeting Time(s)

M,W,F period 6 (12:50-1:40) and F period 7 (1:55-2:45)

Course Meeting Location(s)

Lectures M,W,F at BAR 211. Lab on Friday PM 1:55-2:45 at MCCA 1142

Recommended Materials

Textbooks or Other Readings (Not required)

Rice 1995. Mathematical Statistics.

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

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/ Essay reading assignment
2	Sampling distributions
3	Discrete probability distributions I: a Mark-recapture example introducing Maximum Likelihood (The binomial and hyper-geometric distributions)
4	Discrete probability distributions II: Abundance models (The Poisson distribution)
5	Continuous distributions I: The approximated likelihood function for continuous models: Waiting times (The Exponential and the Gamma distributions)
6	Discrete probability distributions III: Heterogeneity in Ecology (The Negative Binomial Model) and Probability Generating Functions
7	Discrete probability distributions IV: Mark recapture models revisited and Likelihood Ratio Goodness of Fit test (The Multinomial distribution, contingency tables, the reduced-parameter multinomial distribution as a general inference tool).
8	Maximum Likelihood inference I (Fisher's information and Wald's theorem)
9	Maximum Likelihood inference II (Profile Likelihood and Likelihood Ratio Tests) and classical tests as Likelihood Ratio Tests: a review of T-tests, Bartlett tests, ANOVA tests
10	Maximum Likelihood inference III and Computer intensive methods (The Delta method and Parametric Bootstrap)
11	Maximum Likelihood inference IV and Computer intensive methods (Generalized Linear Models)
12	Computer intensive methods: MCMC
13	Computer intensive methods and Bayesian Statistics
14	Computer intensive methods: MCMC, Bayesian Statistics and ML inference through Data Cloning
15	Review or 'catch up' week + poster presentation

Attendance Policy

Students are expected to be on time for class. A maximum of 3 absences are allowed.

Conduct in Class

- Please be courteous and do not talk during lecture. This can be distracting to other students and the instructor.
- Only approved electronic devices may be used in class. Approved electronic devices are laptop computers (when used to take notes or otherwise participate in classroom activities) and voice

recording devices. Unapproved electronic devices include cell phones, video recorders, digital cameras and MP3 players.

Grading

- Homework/quizzes: 15 @ 20 points each (75% of final grade)
- Final Exam (joint project allowed): 100 points (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

Make-up Exam Policy

No make up exam will be given unless the student informs the instructor one week in advance from the scheduled test/quiz. Students with disabilities that need special accommodations for testing are required to inform the instructor about it on the first day of class.

UF Counseling Services

- Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
  - UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
  - Career Resource Center, Reitz Union, 392-1601, career and job search services.
- Many students experience test anxiety and other stress related problems. "A Self Help Guide for Students" is available through the Counseling Center (301 Peabody Hall, 392-1575) and at their web site: http://www.counsel.ufl.edu/.

Honesty Policy

- All students registered at the University of Florida have agreed to comply with the following statement: "I understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University."
- In addition, on all work submitted for credit the following pledge is either required or implied: "*On my honor I have neither given nor received unauthorized aid in doing this assignment*."
- If you witness any instances of academic dishonesty in this class, please notify the instructor or contact the Student Honor Court (392-1631) or Cheating Hotline (392-6999). For additional information on Academic Honesty, please refer to the University of Florida Academic Honesty Guidelines at: http://www.dso.ufl.edu/judicial/procedures/academicguide.html.

Accommodation for Students with Disabilities

- Students who will require a classroom accommodation for a disability must contact the Dean of Students Office of Disability Resources, in Peabody 202 (phone: 352-392-1261). Please see the University of Florida Disability Resources website for more information at: http://www.dso.ufl.edu/drp/services/.
- It is the policy of the University of Florida that the student, not the instructor, is responsible for arranging accommodations when needed. Once notification is complete, the Dean of Students Office of Disability Resources will work with the instructor to accommodate the student.

Software Use

All faculty, staff and student 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.