Course Number and Title
ZOO4927-Spring 2015: Biological models in R

Catalog Description
This course is intended as an introduction to mathematical modeling in ecology and evolution using R. The objective of this course is two-folded: First, to acquaint undergraduate biologists with R programming as a quantitative and graphical tool in biological research and second, to acquire an understanding of the basic elements of mathematical modeling in ecology and evolution. Topics covered include population dynamics modeling (deterministic and stochastic), community ecology, population genetics and stochastic models in population genetics. Pre-requisites: one or two semesters of calculus. The course begins with a three-weeks period of only R-programming with daily exercises and homework, and then moves on to topics in biological research. The course is intended to be a springboard for students willing to pursue a career using analytical and computer intensive tools in their everyday research in the biological sciences.

Credit Hours
3 credit hours

Pre-requisites and Co-requisites
At least one calculus course is required. A basic probability and statistics course and/or linear algebra are also highly desirable, but not required.

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

• Be able to design, write, test and debug simple and functional R code to carry a basic data exploration and analysis
• Be familiar with the R language, creating, saving and running R scripts, creating and running functions in R, making publication-level figures in R, data input and output, writing loops, learn to use logic and control operators, be familiar with basic matrix operations in R, basic probability distributions, arrays and lists manipulations and numerical optimizer routines.
• 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 and statistical modeling
• Identify future course work directions in Statistics

Instructor Information
Name: Jose Miguel Ponciano
Office location: Carr Hall 309
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E-mail address: josemi@ufl.edu
Web site: http://people.biology.ufl.edu/josemi/
Office hours: Wednesdays, 2:30-3:30 or by appointment, Carr Hall 309

Course Meeting Time(s)
Tuesdays and Thursdays, periods 2 and 3 (8:30-10:25)
Course Meeting Location(s)
MCCB 2102

Course Website
Under construction

Recommended Materials

Textbooks or Other Readings (Not required)
None required. Any book introducing readers to R in the biological sciences is welcome

Software (Required)
R, freely distributed at http://www.r-project.org

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

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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| 1    | Part 1: learning R  
Getting started in R, R scripts, functions and a real world example |
| 2    | Data input and output, loops, logic and control. Matrix arithmetic, numerical optimizers. Eigenvalues and eigenvectors. |
| 3    | Basic and advanced graphs in R. Introduction to Latex |
| 4    | Basic Unix commands and R. Running programs in other languages from R.  
End of Part 1. |
| 5    | Part 2: Ecological models in R |
| 6    | Exponential growth, density-dependence, Allee effects, migration, systems of coupled D.E. |
| 7    | Analysis of systems of coupled D.E. using paper, pencil, erasers and R! |
| 8    | Part 3: Probability models in Ecology and Evolution using R  
Discrete probability distributions: capture-recapture models, abundance models, classic mutation models. The likelihood function for discrete probability models.  
Basic Network models in R. |
| 9    | Continuous distributions I: Waiting times (The Exponential and the Gamma distributions), the Coalescent process in population genetics |
| 10   | Continuous distributions II: the multivariate normal distribution and a brief introduction to multivariate statistics. |
| 11   | Likelihood Ratio Goodness of Fit test for (The Multinomial distribution, contingency tables, the reduced-parameter multinomial distribution as a general inference tool). |
| 12   | Maximum Likelihood inference: a deeper look and links with modern and applied research in Ecology, Genetics and Evolution |
| 13   | Part 4: A brief introduction to stochastic processes with applications in Population dynamics and in Phylogenetics |
| 14   | An introduction to phylogenetic models in R |
| 15   | Review, prep for final exam |

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 nor check your cell phone 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: 15 @ 20 points each (35% of final grade)
- Two exams and one final exam: 100 points each (55% of final grade). An A in both exams exempts the student from the final. Each one of the two exams is part in-class with open notes and part home-take.
- Class Participation: 10 % of final grade

Grading Scale

<table>
<thead>
<tr>
<th>Point Range (%)</th>
<th>Letter Grade</th>
<th>GPA equivalent</th>
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<tbody>
<tr>
<td>≥ 90.00</td>
<td>A</td>
<td>4.0</td>
</tr>
<tr>
<td>86.7 – 89.9</td>
<td>A-</td>
<td>3.67</td>
</tr>
<tr>
<td>83.3 – 86.6</td>
<td>B+</td>
<td>3.33</td>
</tr>
<tr>
<td>80.0 – 83.2</td>
<td>B</td>
<td>3.0</td>
</tr>
<tr>
<td>76.7 – 79.9</td>
<td>B-</td>
<td>2.67</td>
</tr>
<tr>
<td>73.3 – 76.6</td>
<td>C+</td>
<td>2.33</td>
</tr>
<tr>
<td>70.0 – 73.2</td>
<td>C</td>
<td>2.0</td>
</tr>
<tr>
<td>66.7 – 69.9</td>
<td>C-</td>
<td>1.67</td>
</tr>
<tr>
<td>63.3 – 66.6</td>
<td>D+</td>
<td>1.33</td>
</tr>
<tr>
<td>60.0 – 63.2</td>
<td>D</td>
<td>1.0</td>
</tr>
<tr>
<td>56.7 – 59.9</td>
<td>D-</td>
<td>0.67</td>
</tr>
<tr>
<td>&lt; 56.7</td>
<td>E</td>
<td>0</td>
</tr>
</tbody>
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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.