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Likelihood & Bayesian Ecology (BIOS 952)

Fall 2020 mini-session
3 credits
Three weeks, Nov 30 - Dec 18, Monday through Friday
Instructor: Chad Brassil (cbrassil@unl.edu, 402-419-0076, Manter 416)
Online Discussion via Zoom: 9:00 AM – 10:00 AM and 1:00 PM – 2:00 PM
Drop-in Office Hours: 2:30 – 3:30 PM and/or by appointment

Contents

Inclusion Statement

All students are welcome in this course. All students shall exhibit respect for each other so that we can foster an engaged learning environment. Please communicate barriers to learning, and I will strive to remove them. Together, let us foster an inclusive learning environment.

Learning Goals

The learning goal of this course is to use maximum likelihood and Bayesian analysis as statistical tools applied to ecological data sets broadly defined. While many of the examples in the texts may emphasis specific ecological uses, for example time series in population dynamics, the aim is to teach the course in a way that tools can broadly be used in many areas of biology, including behavioral and evolutionary biology. The emphasis will be on use of the methods, including an understanding of assumptions, coding in R, and practice data sets. The final project will be a student-developed analysis on data of the student's own interest, which will further facilitate the translation of these methods to useful approaches within the research of each participant.

Prerequisites

There are no formal prerequisites for this course although students will benefit from prior exposure to any statistical course work, even introductory undergraduate statistics. Prior exposure to the program R is also beneficial, and BIOS 967 Introduction to R for Biological Sciences is excellent preparation for this course.

Contact Information

Busy/free times on my calendar can be viewed at <http://www.unl.edu/cbrassil/calendar>. In addition, feel free to stop by my office any time, 416 Manter Hall or give me a call at 402-419-0076. I can be reached via email at cbrassil@unl.edu, although you will receive a more immediate answer via phone or by drop-in.

Disability Assistance

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can discuss options privately. To establish reasonable accommodations, I may request that you register with Services for Students with Disabilities (SSD). If you are eligible for services and register with their office, make arrangements with me as soon as possible to discuss your accommodations so they can be implemented in a timely manner. SSD contact information: 232 Canfield Admin. Bldg.; 402-472-3787.

Counseling and Psychological Services

UNL offers a variety of options to students to aid them in dealing with stress and adversity. Counseling and Psychological & Services (CAPS) is a multidisciplinary team of psychologists and counselors that works collaboratively with Nebraska students to help them explore their feelings and thoughts and learn helpful ways to improve their mental, psychological and emotional well-being when issues arise. CAPS can be reached by calling 402-472-7450. Big Red Resilience & Well-Being (BRRWB) provides one-on-one well-being coaching to any student who wants to enhance their well-being. Trained well-being coaches help students create and be grateful for positive experiences, practice resilience and self-compassion, and find support as they need it. BRRWB can be reached by calling 402-472-8770.

Academic Honesty

Academic honesty is essential to the existence and integrity of an academic institution. The responsibility for maintaining that integrity is shared by all members of the academic community. The University's Student Code of Conduct addresses academic dishonesty. Students who commit acts of academic dishonesty are subject to disciplinary action and are granted due process and the right to appeal any decision.

The disciplinary action for violations of the UNL Student Code of Conduct, including ***plagiarism or cheating*** will result in an F for the course.

Class Periods

Readings are indicated by the chapter number from Hobbs and Hooten. The chapters should be read before the start of the listed class period. Occasionally, recorded lectures will summarize my perspective on the material. During our discussion time we will work together to fully understand the reading material. The method by which we work through the material will vary. Sometimes class members will lead discussion, sometimes we will work within groups.

	Date	No.	Readings/Assignments	Topics
M	30-Nov	1	AM: Kruschke Ch 3 PM: Preface & Ch 1	AM: Introduction to course & R PM: Models
Tu	1-Dec	2	AM: Ch 2 4:00 PM: Ch 3	AM: Deterministic Models & Plot in R PM: Principles of Probability
W	2-Dec	3	AM: Appendix A 4:00 PM: Ch 4	AM: Distributions & Simulate in R PM: Likelihood & Averages in R
Th	3-Dec	4	AM: Ecological Detective: 59-62,131-151 4:00 PM: Ecological Detective: 59-62,152-167; Burnham & Anderson: 70-72	AM: Continuous variables PM: Model comparison, AIC, and confidence intervals
F	4-Dec	5	AM: Ecological Detective: 171-179 PM: Ch 5	AM: Categorical variables and rebuilding an ANOVA PM: Simple Bayesian Models
M	7-Dec	6	AM: Ch 6 PM: Ch 7	AM: Hierarchical Bayesian Models PM: Markov Chain Monte Carlo
Tu	8- Dec	7		AM: Rat Growth data in JAGS and R PM: Multiple Choice data set in JAGS
W	9- Dec	8	AM: Ch 8	AM: Inference from a Single Model PM: Code in R
Th	10-Dec	9	AM: Ch 9 PM: Ch 10	AM: Inference from Multiple Models PM: Writing Bayesian Models
F	11-Dec	10	Ch 11.1 & Ch 11.2 & 11.3	Problems
M	14-Dec	11	Ch 11.4 & 11.5	Problems
Tu	15-Dec	12	AM: Published Paper Hobbs and Hooten: Afterword PM: Present Project Idea	AM: Discuss and replicate analysis PM: Feedback on Project Ideas
W	16-Dec	13	PM: submit draft of figures and analysis for feedback	Work on Projects with Feedback
Th	17-Dec	14	AM: Assigned one of: a) Ecological Detective: pg 12-23 b) Ellison. 2004. Ecology Letters c) Clark. 2005. Ecology Letters d) Lee & Dennis. 2009. Eco App	AM: Frequentist vs Bayesian debate (Jigsaw); PM: Work on Projects with Feedback
F	18-Dec	15	Presentations of Projects	

Required Materials

1) Hobbs, N. Thompson and Mevin B. Hooten. 2015. Bayesian Models: A statistical primer for Ecologists. Princeton University Press. Princeton, NJ. ISBN: 978-0-691-15928-7. http://ebookcentral.proquest.com.libproxy.unl.edu/lib/unebraskalincoln-ebooks/detail.action?docID=1983781

Errata at: http://www.stat.colostate.edu/~hooten/papers/pdf/Hobbs_Hooten_Bayesian_Models_2015_errata.pdf

2) A ***notebook computer*** which can run R is also required. The program R is free and available at http://mirror.las.iastate.edu/CRAN/.

Supplementary material will be drawn from the following texts. They are listed here for reference purposes. Critical information will be provided as needed, and there is no need to purchase the following texts. Some of the books are available digitally within the UNL library system, in which case links are listed.

Hilborn, Ray and Mangel. 1997. The Ecological Detective: Confronting models with data. Princeton University Press. Princeton, NJ. http://libproxy.unl.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=529481&site=ehost-live

Kruschke, John K. 2015. Doing Bayesian Data Analysis: a tutorial with R, JAGS, and Stan. 2nd ed. Elsevier, Amsterdam. https://www-sciencedirect-com.libproxy.unl.edu/science/book/9780124058880

Burnman, Kenneth P. and David R. Anderson. 2002. Model Selection and Multimodel Inference. Springer. New York.

Bolker, Benjamin M. 2008. Ecological Models and Data in R. Princeton University Press. Princeton, NJ.

Clark, James S. 2007. Models for Ecological Data. Princeton University Press. Princeton, NJ.

McCarthy, Michael A. 2007. Bayesian Methods for Ecology. Cambridge University Press. New York.

Gelman, Andrew and Jennifer Hill. 2007. Data Analysis Using Regression and Multilevel/Hierarchical Models. Cambridge University Press. New York.

Hooten, M. B. and N. T. Hobbs. 2015. A guide to Bayesian model selection for ecologists. *Ecological Monographs* 85:3–28. http://dx.doi.org/10.1890/14-0661.1

Kery, Marc. 2010. Introduction to WinBUGS for Ecologists. Elsevier. Amsterdam. http://libproxy.unl.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=334578&site=ehost-live

Participation

Much of this class will be structured around the benefits of group learning via discussion, and participation is central to that process. Regular participation points will be posted throughout the semester so as to keep you informed of my view of your engagement in the learning process and your engagement in assisting your group in learning the material.

Pre-class Questions & Code Checks

Prior to each class period there will be a series of open-ended online questions. Thoughtfully answer each of these questions in order to prepare for class discussion and in order to identify those areas in which you are still working on your understanding. In some cases I will read through the answers you submit. However, the primary purpose of these writing exercises are to structure your own reflection and learning.

Periodically throughout the course, you will be asked to submit your R code for various exercises or example data sets. In part this will be used to check on the progress of each participant, and in part this will be used to ensure the full participation of each person. There is no better way to learn the statistical analysis that doing statistical analysis.

Projects

You can work on a project individually or in a team of two people. A team can be beneficial because you can help each other think creatively, work on bugs, and support each other. In the projects you will work up a dataset using likelihood and/or Bayesian techniques from the course. The last week of class is focused on assistance/feedback from classmates and the instructor. You will present of figures, analysis and results to the class in a format appropriate for a lab meeting.

Grades

Cumulative grade percent will be determined using the following weighting by category. A quarter of the grade is pre-class preparation, a quarter of the grade is on in-class participation, and half the grade is on the final project.

Percent	Category
25%	**Participation**
15%	**Pre-class Questions**
10%	**Code Checks**
50%	**Presentation on Project**

Final letter grades will be determined via the following scale, in other words 90.0% or higher is an A-.

Letter	F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
Min %		60.0%	63.0%	67.0%	70.0%	73.0%	77.0%	80.0%	83.0%	87.0%	90.0%	93.0%	98.0%