Methods in Experimental Ecology II

PCB 6468

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Room: Biology 305

Time: Wednesdays and Fridays (2:30 – 3:20 PM)

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Class website:

http://sciences.ucf.edu/biology/d4lab/methods-2/ - here you will find all the materials necessary for classes and exercises.

Spring 2024

Course description:
This course will assist students to design, analyze and interpret their own experiments and observations and establish a research program in ecology and other biological fields. This course reviews aspects of statistical modeling to help make decisions on the collection, organization and interpretation of ecological data. It is based on the revision of case studies illustrating frequent research problems and the discussion of potential solutions. As much as possible, alternative approaches are evaluated and compared. This class complements courses on basic statistics and is directed to beginning graduate and senior undergraduate researchers. The course confronts concepts in experimental design, execution and analysis as a tool to improve ecological research.

Prerequisites:
PCB 6466 Methods in Ecology I or Instructor Consent (CI)

This class will provide basic information and practical advice on how to ask pertinent questions, and improve experimental execution, design, analysis and interpretation in ecology.

Estimated enrollment: **10-20**

Methods in experimental ecology II

Course Outline

This course constitutes a review of analysis and modeling methods in ecology. Individual sections cover aspects of data collection, analysis and interpretation of ecological observations, experiments, and measurements of organisms and the environment.

Main goals for students in this course:

- **Design sampling programs that represent the best use of available resources**
- **Avoid mistakes that make data difficult to analyze**
- **Review and discuss case studies to recognize common research problems in ecology**
- **Apply available statistical analysis in a critical way to address ecological research problems**
- **Compare different ecological and statistical techniques**
- **Recognize the advantages and limitations of different approaches to evaluate ecological data**

Course Prerequisites: The student should have taken PCB 6466 Methods in Ecology I or Instructor Consent (CI)

Student duties:
Conduct: Students must follow the University standards for personal and academic conduct as outlined in the Golden Rule (http://www.goldenrule.sdes.ucf.edu/).

Demos: Students will complete daily in-class exercises using R and other programs, and discuss, analyze and interpret ecological data.

Exercises: For each topic, students will have one week to complete an exercise.

Readings:
Specialized literature will be used to review examples of experimental ecology research and specific topics.

The course is organized by weekly sessions. Each session has four components: theory, demonstration, implementation, and review. The first two are developed with guidance in class, the last two are done with support but independently by each student.

Class schedule:

Session	TOPIC	Demo completed	Class dates **/ return exercise**
0	**Class presentation**		January 10
1	**Why to spend time with stats?**		January 12
	Exercise 1 (and Extra Credit)		**January 17**
2	**Why to worry about assumptions?**		January 17-19
	Exercise 2		**January 24**
3	**Three Frameworks of Analysis**		January 24-26
	Exercise 3		**January 31**
4	**Why Bayesian? The model of the mean**		January 31- February 2
	Exercise 4		**February 7**
5	**How to analyze binary responses?**		February 7-9
	Exercise 5		**February 14**
6	**How to analyze non-linear relationships?**		February 14-16
	Exercise 6		**February 21**
7	**How to deal with count data?**		February 21-23
	Exercise 7		**February 28**
8	**Why linear mixed models?**		February 28-March 1
	Exercise 8		**March 6**
9	**Model selection for mixed models**		March 6-8
	Exercise 9		**March 13**
10	**Model selection for mixed models II**		March 13-15
	Exercise 10		**March 27**
	Spring Break		***March 18-22***
11	**Models for data with too many zeros**		March 27-29
	Exercise 11		**April 3**
12	**Non-linear count data**		April 3-5
	Exercise 12		**April 10**
13	**Hierarchical models: variances**		April 10-12
	Exercise 13		**April 17**
	Closing remarks		April 17-19

Performance Evaluation:

- *13 exercises. Each exercise will either be accepted or not accepted. Non-accepted exercises will be returned along side an explanation for the decision. Students have the option to dispute the decision (by providing a valid argument for why the exercise should be accepted) or resubmitting a modified version of the exercise for evaluation. This process can be repeated until the exercise is accepted.*
- *Grade scale:* *A = 10 accepted exercises*
  B = 9 accepted exercises
  C = 8 accepted exercises
  D = 7 accepted exercises
  F= 6 or less accepted exercises

EXAMPLES OF SUPPORT AND ADDITIONAL REFERENCES

Burgman, M. 2011. Remedies for a scientific disease. Bulletin of the British Ecological Society 42:1

Burnham K. P. and D. Anderson. 2002. Model selection and multimodal inference. Springer.

Colegrave, N and G. D. Ruxton. Confidence intervals are a more useful complement to nonsignificant tests than are power calculations. Behavioral Ecology 14: 446-450.

Crawley, M. J. 2005. Statistics: an introduction using R. Wiley.

Crowley, P. H. 1992. Resampling methods for computation-intensive data analysis in ecology and evolution. Annual Review of Ecology and Systematics 23: 405-447.

Eberhardt, L.L. and J.M. Thomas. 1991. Designing environmental field studies. Ecological Monographs 61: 53-73.

Ellison, A.M. 1996. An introduction to Bayesian inference for ecological research and environmental decision-making. Ecological Applications 6: 1036-1046.

Fidler, F., M. A. Burgman, G. Cumming, R. Buttrose, and N. Thomason. 2006. Impact of criticism of null-hypothesis significance testing on statistical reporting practices in Conservation Biology. Conservation Biology 20: 1539-1544.

Dutilleul, P. 1993. Spatial heterogeneity and the design of ecological field experiments. Ecology 7: 1617-1628.

Quinn, M. and J. Keough. 2002. Experimental Design and Data Analysis for Biologists Cambridge.

Gibson, D.J. 2002. Methods in comparative plant population ecology. Oxford.

Gotelli and Ellison. 2004. A Primer of Ecological Statistics. Sinauer.

Gurevitch, J. and T. Chester. 1986. Analysis of repeated measures experiments. Ecology 67: 251-255.

Hilborn, R. and M. Mangel. 1997. The Ecological Detective: confronting models with data. Princeton.

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

Hoenig, J. M. and D. M. Heisey. 2001. The abuse of power: the pervasive fallacy of power calculations for data analysis. The American Statistician 55: 19-24.

Magnusson and Mourão . 2004. Statistics without Math. Sinauer.

McCarthy, M.A. 2007. Bayesian methods for Ecology. Cambridge.

McElreath, R.M. 2016. Statistical Rethinking: a Bayesian course with examples in R and Stan. Chapman and Hall.

Manly B.F.J. 1997. Randomization, Bootstrap and Monte Carlo Methods in Biology, Chapter 1. Chapman & Hall

McKone, M.J. y C.M. Lively. 1993. Statistical analysis of experiments conducted at multiple sites. Oikos 67: 184-186

Scheiner, S. M. and J. Gurevitch. 1993. Design and analysis of Ecological Experiments. 1993. Chapman Hall.

Potvin, C., M.J. Lechowicz y S. Tardif. 1990. The statistical analysis of ecophysiological reposponse curves obtained from experiments involving repeated measures. Ecology 71: 1389-1400.

Potvin, C. and D.A. Roff. 1993. Distribution-free and robust statistical methods: viable alternatives to parametric statistics? Ecology 74: 1617-1628.

Platt, J.R. 1964. Strong inference. Science 146: 346-353.

Quintana-Ascencio, P. F., Lopez Borghesi, F., Menges, E. S. 2022. Statistical Modeling for Naturalists. Cambridge Scholars Publishing.

Shen, J. 1995. On choosing an appropriate ANOVA for ecological experiments Oikos 73: 404.

Sokal, R.R. y F.J. Rohlf. Biometry: The Principles and Practice of Statistics in Biological Research, Chapter 10. W.H. Freeman, New York.

Stephens, P. A., S. W. Buskirk, and C. Martinez del Rio. 2006. Inference in ecology and evolution. Trends in Ecology and Evolution 22: 193-196.
Underwood, A.J. 1998. Experiments in Ecology; Their Logical Design and Interpretation Using Analysis of Variance, Chapter 2. Cambridge University Press, Cambridge.