Methods in Experimental Ecology
PCB 6466

Character abbreviation:
Met Ecol.**; 3 (3,0)**

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Class website: http://pascencio.cos.ucf.edu/SiteMethods.html - here you will find all the materials necessary for classes and exercises.

Fall 2013

Course description:
This course will assist graduate 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 basic analytical tools needed to collect, organize and interpret ecological data in a critical way. It is based on the revision of case studies illustrating frequent research problems and the discussion of potential solutions. As much as possible, several 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 3034 Principles of Ecology 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

Course Outline

This course constitutes an introduction to experimental methods in ecology. Individual sections cover aspects of data collection, analysis and interpretation of ecological 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 our 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 3034 Principles of Ecology 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: We suggest the use Crawley M.J, "Statistics: An Introduction Using R" to facilitate application of the concepts using the open source program R. We also suggest: Gotelli and Ellison, 2004. "A Primer of Ecological Statistics" and McCarthy, M.A. 2007. "Bayesian methods for Ecology".

Specialized literature will be used to review examples of experimental ecology research and specific topics. These readings initiate with: **Steven Johnson. 2006. The Ghost Map. Riverhead Books**. Assigned readings for each week will be on the class website. Questions on their content will be included in the tests.

Class schedule:

DATE	Room	TOPIC	READING
20-Aug	Bio-305	Course Introduction	
22-Aug	Bio-305	Probability Distributions / Exercise 1A	Ellison and Dennis 2010
27-Aug	Bio-305	R Demo: Probability Distributions / Exercise 1B	
29-Aug		*No classes (Football Game)*	
3-Sep	Bio-305	R Demo: Managing Data / Exercise 2	
5-Sep	Bio-305	Sampling and Experimental Design	Burgman 2011
7–Sep	**Field**	**Field trip to collect data**	
10-Sep	Bio-305	R Demo: Summary Statistics / Exercise 3	
12-Sep	Bio-305	Statistical models	Hurlbert 1984
17-Sep	Bio-305	Confidence intervals	Fiedler et al 2006
19-Sep	Bio-305	R Demo: Confidence Intervals / Exercise 4	
24-Sep	Bio-305	Three Frameworks	Crowley 1992
26-Sep	Bio-305	R Demo: Three Frameworks / Exercise 5	
1-Oct	Bio-305	Regression	Ellison 1996
3-Oct	Bio-305	R Demo: Regression / Exercise 6	
8-Oct	**Bio-305**	**EXAM #1**	
10-Oct	Bio-305	Multiple regression	Stephens et al. 2006
15-Oct	Bio-305	R Demo: Multiple Regression / Exercise 7	
17-Oct	Bio-305	Multimodel selection	Buckland et al. 2008
22-Oct	Bio-305	R-Demo: Model selection / Exercise 8	
24-Oct	Bio-305	General linear models (ANOVA)	Bolker et al. 2008
29-Oct	Bio-305	R Demo: ANOVAs / Exercise 9	
31-Oct	Bio-305	General linear models (ANCOVA)	Hoenigand and Heisey 2001
5-Nov	Bio-305	R Demo: ANCOVAs / Exercise 10	
7-Nov	**Bio-305**	**EXAM #2**	
12-Nov	Bio-305	Multiple comparisons	Day and Quinn 1989
14-Nov	Bio-305	R Demo: Multiple Comparisons / Exercise 11	
19-Nov	Bio-305	Logistic Regression	Colegrave and Ruxton 2002
21-Nov		*No classes (Football Game)*	
26-Nov	Bio-305	R Demo: Logistic Regression / Exercise 12	
28-Nov		*No classes (Thanksgiving)*	
TBD	Bio-305	Analyzing Categorical Data	Johnson 2003, 2005
TBD	Bio-305	R Demo: Categorical Data / Exercise 13	
		FINAL EXAM (as scheduled)	

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.
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: 184-186Scheiner, 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.
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.

Performance Evaluation:

- *13 exercises. We only consider the 10 best (5 points each) = 5 x 10 =50*
- *Two exams: content cumulative (15 points each) 15 x 2 = 30*
- *Final (20 points)*
- *Total 50 + 30 + 20 = 100*
- *Grade scale: A = 90-100; B = 80-89; C = 70-79; D = 60-69; F= below 60*