

Course Overview, Schedule, Readings

About Biology 599: Ecological Data Analysis

Expectations



1. We will meet twice a week throughout the term. I expect you to attend all classes and actively participate.
2. Please communicate via email. I will typically respond within 48 hours but not on weekends or holidays.
3. This course requires no prior knowledge of R, but I expect you have taken introductory statistics.

Course Learning Objectives



Upon successful completion of the course, you will be able to:

1. Develop proficiency in the programming language R.
2. Use R to manipulate, summarize, analyze, and interpret data.
3. Choose appropriate analysis techniques for a variety of data types and formats.
4. Understand regression-type analysis ranging from simple linear regression to more complex generalized linear mixed effects models, and how to apply them.
5. Create publication-ready graphics and learn what to write in a paper.

Course Schedule



Course Readings



Week 1: No Reading – Introduction to R

Week 2: Applied statistics in Ecology:

<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/ES13-00160.1> ↗
(<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/ES13-00160.1>)

Week 3: Writing statistical methods for

ecologists: <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.4539> ↗

(<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.4539>).

Week 4: Machine Learning <https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.14061> ↗ (<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.14061>).

Week 5: ↗ (<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.4539>) Neglected biological patterns in the residuals: <https://link.springer.com/article/10.1007/s00265-011-1254-7> ↗ (<https://link.springer.com/article/10.1007/s00265-011-1254-7>).

Week 6: A brief introduction to mixed effects modelling and multi-model inference in ecology: <https://peerj.com/articles/4794/> ↗ (<https://peerj.com/articles/4794/>).

Week 7: A practical guide to selecting models for exploration, inference, and prediction in ecology: <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecy.3336> ↗ (<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecy.3336>).

Week 8: Statistics For Correlated Data: Phylogenies, Space, And

Time: [https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/04-0702?](https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/04-0702?casa_token=7sJeglbvSQ4AAAAA%3AU5Lj_Y0Shza1nIRQS2ZZLIHWpjhWiGg2ByrQH_UxuxEhVkJ2M-bG0Y4WcegyrU32qFDj2wfSw-vYUT)

[casa_token=7sJeglbvSQ4AAAAA%3AU5Lj_Y0Shza1nIRQS2ZZLIHWpjhWiGg2ByrQH_UxuxEhVkJ2M-bG0Y4WcegyrU32qFDj2wfSw-vYUT](https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/04-0702?casa_token=7sJeglbvSQ4AAAAA%3AU5Lj_Y0Shza1nIRQS2ZZLIHWpjhWiGg2ByrQH_UxuxEhVkJ2M-bG0Y4WcegyrU32qFDj2wfSw-vYUT) ↗

([https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/04-0702?](https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/04-0702?casa_token=7sJeglbvSQ4AAAAA%3AU5Lj_Y0Shza1nIRQS2ZZLIHWpjhWiGg2ByrQH_UxuxEhVkJ2M-bG0Y4WcegyrU32qFDj2wfSw-vYUT)

[casa_token=7sJeglbvSQ4AAAAA%3AU5Lj_Y0Shza1nIRQS2ZZLIHWpjhWiGg2ByrQH_UxuxEhVkJ2M-bG0Y4WcegyrU32qFDj2wfSw-vYUT](https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/04-0702?casa_token=7sJeglbvSQ4AAAAA%3AU5Lj_Y0Shza1nIRQS2ZZLIHWpjhWiGg2ByrQH_UxuxEhVkJ2M-bG0Y4WcegyrU32qFDj2wfSw-vYUT)).

Week 9: Count data in biology—Data transformation or model reformation?

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5869353/> ↗

(<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5869353/>).

Week 10: Generalized linear mixed models: a practical guide for ecology and evolution:

[https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347\(09\)00019-6?mobileUi\u003d0\u0026code\u003dcell-site="](https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347(09)00019-6?mobileUi\u003d0\u0026code\u003dcell-site=) ↗ ([https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347\(09\)00019-6?mobileUi\u003d0\u0026code\u003dcell-site="](https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347(09)00019-6?mobileUi\u003d0\u0026code\u003dcell-site=)).

Week 11: What does a zero mean?

<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.13185> ↗

(<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.13185>).

Week 12: Hierarchical generalized additive models in ecology: an introduction with mgcv: <https://peerj.com/articles/6876/> ↗ (<https://peerj.com/articles/6876/>).

Additional Readings:

A protocol for data exploration to avoid common statistical problems

<https://besjournals.onlinelibrary.wiley.com/doi/10.1111/j.2041-210X.2009.00001.x> ↗
(<https://besjournals.onlinelibrary.wiley.com/doi/10.1111/j.2041-210X.2009.00001.x>)

A protocol for conducting and presenting results of regression-type analyses

<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.12577> ↗
(<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.12577>)

Ten Simple Rules for Better Figures

<https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833> ↗
(<https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833>)

Confidence intervals are a more useful complement to nonsignificant tests than are power calculations

<https://academic.oup.com/beheco/article/14/3/446/257432> ↗
(<https://academic.oup.com/beheco/article/14/3/446/257432>)

Power Analysis in Mixed models

<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.12306> ↗
(<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.12306>)

SIMR: an R package for power analysis of generalized linear mixed models by simulation

<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.12504> ↗
(<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.12504>)

Correcting for Regression to the Mean in Ecology

<https://www.jstor.org/stable/10.1086/497402> ↗ (<https://www.jstor.org/stable/10.1086/497402>)

When are hypotheses useful in ecology and evolution?

<https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.7365> ↗
(<https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.7365>)

Why do we still use stepwise modelling in ecology and behaviour?

<https://besjournals.onlinelibrary.wiley.com/doi/10.1111/j.1365-2656.2006.01141.x> ↗
(<https://besjournals.onlinelibrary.wiley.com/doi/10.1111/j.1365-2656.2006.01141.x>)

Arguments for rejecting the sequential Bonferroni in ecological studies

<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.2041-210X.2012.00195.x> ↗
(<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.2041-210X.2012.00195.x>)

Spatial autocorrelation and statistical tests in ecology

<https://www.tandfonline.com/doi/epdf/10.1080/11956860.2002.11682702?needAccess=true> ↗

(<https://www.tandfonline.com/doi/epdf/10.1080/11956860.2002.11682702?needAccess=true>)

SPATIAL AUTOCORRELATION AND AUTOREGRESSIVE MODELS IN ECOLOGY

https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/0012-9615%282002%29072%5B0445%3ASAAAMI%5D2.0.CO%3B2?casa_token=mfcl6R4-oykAAAAA%3A5_TuI7N7Kq220i-QGJyFy-I4ZFa0q2IS14SL9h2nuVKzV8W19VFllms1NS6-bhVsRjTGov9rh4lliJXS ↗ (https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/0012-9615%282002%29072%5B0445%3ASAAAMI%5D2.0.CO%3B2?casa_token=mfcl6R4-oykAAAAA%3A5_TuI7N7Kq220i-QGJyFy-I4ZFa0q2IS14SL9h2nuVKzV8W19VFllms1NS6-bhVsRjTGov9rh4lliJXS)

Spatial autocorrelation and pseudoreplication in fire ecology

<https://link.springer.com/article/10.4996/fireecology.0202107> ↗

(<https://link.springer.com/article/10.4996/fireecology.0202107>)

The earth is round

<https://psycnet.apa.org/doiLanding?doi=10.1037%2F0003-066X.49.12.997> ↗

(<https://psycnet.apa.org/doiLanding?doi=10.1037%2F0003-066X.49.12.997>)

Using false discovery rates for multiple comparisons in ecology and evolution

<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.2041-210X.2010.00061.x> ↗

(<https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.2041-210X.2010.00061.x>)

Confronting Multicollinearity in Ecological Multiple Regression

<https://esajournals.onlinelibrary.wiley.com/doi/10.1890/02-3114> ↗

(<https://esajournals.onlinelibrary.wiley.com/doi/10.1890/02-3114>)

A practical guide and power analysis for GLMMs: detecting among treatment variation in random effects

<https://peerj.com/articles/1226/> ↗ (<https://peerj.com/articles/1226/>)

Modelling Palaeoecological Time Series Using Generalised Additive Models

<https://www.frontiersin.org/articles/10.3389/fevo.2018.00149/full> ↗

(<https://www.frontiersin.org/articles/10.3389/fevo.2018.00149/full>)