Introduction to Bayesian Statistics for Ecology

Tutor: Prof. Achaz von Hardenberg,
Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia

Pavia, 20-24 January 2025

Course Programme:

Overview
Bayesian statistical methods are increasingly used in ecological research, thanks to advances in computational power and user-friendly statistical languages like WINBUGS and JAGS. These methods enable researchers to specify and analyse complex hierarchical models, providing flexibility and interpretative advantages over frequentist approaches.

This course provides a comprehensive yet accessible introduction to Bayesian methods, equipping participants with the foundational knowledge and practical skills to apply these techniques to their research. Combining theoretical lectures with hands-on practice, attendees will explore Bayesian principles and apply models to ecological data.

The course emphasizes active learning, with participants applying concepts and methods to ecological datasets using JAGS/WINBUGS via R and RStudio. The final session offers an opportunity to work on participants' own data or instructor-provided examples, with personalized guidance.

Course Schedule

Monday, January 20
- Introduction to Bayesian statistics:

- Frequentist vs. Bayesian perspectives on probability
- Fundamentals of probability and Bayes' theorem
- Likelihood and maximum likelihood methods
- Bayes' rule for finite and continuous hypotheses
- Informative and non-informative priors

Tuesday, January 21
- Markov Chain Monte Carlo (MCMC) methods and Gibbs sampling
- Introduction to JAGS/WINBUGS
- Estimating means and differences between means in JAGS/WINBUGS
- Practical session: Guided exercises with simple models

Wednesday, January 22
- Introduction to simple and generalized linear models (GLMs)
- Comparing maximum likelihood and Bayesian approaches using ecological case studies
- Bayesian model selection
- Practical session: Applying GLMs in JAGS

Thursday, January 23
- Hierarchical models in ecology:
- Generalized linear mixed models (GLMMs)
- Capture-mark-recapture models
- Occupancy models
- Practical implementation of hierarchical models in JAGS

Friday, January 24
- Practical application of Bayesian methods to ecological problems:
- Participants' datasets or instructor-provided examples
- Presentation and discussion of analyses
- Course wrap-up and Q&A

Class Hours

The course comprises a total of 28 hours, with with 6 hours of instruction per day. Classes will run from:
- **Morning session:** 9:00 – 12:30
- **Afternoon session:** 14:00 – 16:30

The last session on Friday 24th of January will be 4 hours long from 9:00 to 13:00

Prerequisites

The course is aimed at PhD students, postdoctoral researchers, and professionals interested in applying Bayesian methods to ecological research. Participants should have basic knowledge of simple and generalized linear models (GLMs) and familiarity with the R statistical environment. **The course will be limited to 20 participants. Priority will be given to PhD students.**

For registering to this course please fill out this form before the 10th of January 2025:

https://tinyurl.com/Bayespavia2025