

FINAL CALL for "Applied Bayesian modelling for ecologists and epidemiologists" (ABME03)

Delivered by Dr. Matt Denwood and Emma Howard

www.prstatistics.com/course/applied-bayesian-modelling-ecologists-epidemiologists-abme03/

This 6 day course will run from 20th – 25th November 2017 at SCENE field station, Loch Lomond national park, Scotland.

This application-driven course will provide a grounding in the basic theory & practice of Bayesian statistics, with a focus on MCMC modelling for ecological & epidemiological problems.

Starting from a refresher on probability & likelihood, the course will take students all the way to cutting-edge applications such as state-space population modelling & spatial point-process modelling. By the end of the week, you should have a basic understanding of how common MCMC samplers work and how to program them, and have practical experience with the BUGS language for common ecological and epidemiological models. The experience gained will be a sufficient foundation enabling you to understand current papers using Bayesian methods, carry out simple Bayesian analyses on your own data and springboard into more elaborate applications such as dynamical, spatial and hierarchical modelling.

Course content is as follows

Day 1

- Revision of likelihoods using full likelihood profiles and an introduction to the theory of Bayesian statistics.
 - o Probability and likelihood
 - o Conditional, joint and total probability, independence, Baye's law
 - o Probability distributions
 - o Uniform, Bernoulli, Binomial, Poisson, Gamma, Beta and Normal distributions – their range, parameters and common uses.
 - o Likelihood and parameter estimation by maximum likelihood
 - o Numerical likelihood profiles and maximum likelihood
- Introduction to Bayesian statistics
 - o Relationship between prior, likelihood & posterior distributions
 - o Summarising a posterior distribution: The philosophical differences between frequentist & Bayesian statistics, & the practical implications of these
 - o Applying Bayes' theorem to discrete & continuous data for common data types given different priors
 - o Building a posterior profile for a given dataset, & compare the effect of different priors for the same data

Day 2

- An introduction to the workings of mcmc, and the potential dangers of mcmc inference. Participants will program their own (basic) mcmc sampler to illustrate the concepts and fully understand the strengths and weaknesses of the general approach. The day will end with an introduction to the bugs language.
 - o Introduction to MCMC.
 - o The curse of dimensionality & the advantages of MCMC sampling to determine a posterior distribution.
 - o Monte Carlo integration, standard error, & summarising samples from posterior distributions in R.
 - o Writing a Metropolis algorithm & generating a posterior distribution for a simple problem using MCMC.
 - o Markov chains, autocorrelation & convergence.
 - o Definition of a Markov chain.
 - o Autocorrelation, effective sample size and Monte Carlo error.
 - o The concept of a stationary distribution and burning.
 - o Requirement for convergence diagnostics, and common statistics for assessing convergence.
 - o Adapting an existing Metropolis algorithm to use two chains, & assessing the effect of the sampling distribution on the autocorrelation.
 - o Introduction to BUGS & running simple models in JAGS.
 - o Introduction to the BUGS language & how a BUGS model is translated to an MCMC sampler during compilation.
 - o The difference between deterministic & stochastic nodes, & the contribution of priors & the likelihood.
 - o Running, extending & interpreting the output of simple JAGS models from within R using the runjags interface.

Day 3

- This day will focus on the common models for which jags/bugs would be used in practice, with examples given for different types of model code. All aspects of writing, running, assessing and interpreting these models will be extensively discussed so that participants are able and confident to run similar models on their own. There will be a particularly heavy focus on practical sessions during this day. The day will finish with a discussion of how to assess the fit of mcmc models using the deviance information criterion (dic) and other methods.
 - o Using JAGS for common problems in biology.
 - o Understanding and generating code for basic generalised linear mixed models in JAGS.
 - o Syntax for quadratic terms and interaction terms in JAGS.
 - o Essential fitting tips and model selection.
 - o The need for minimal cross-correlation and independence between parameters and how to design a model with these properties.
 - o The practical methods and implications of minimizing Monte Carlo error and autocorrelation, including thinning.
 - o Interpreting the DIC for nested models, and understanding the limitations of how this is calculated.
 - o Other methods of model selection and where these might be more useful than DIC.
 - o Most commonly used methods Rationale and use for fixed threshold, ABGD, K/theta, PTP, GMYC with computer practicals.
 - o Other methods, Haplowebs, bGMYC, etc. with computer practicals

Day 4

- Day 4 will focus on the flexibility of mcmc, and precautions required for using mcmc to model commonly encountered datasets. An introduction to conjugate priors and the potential benefits of exploiting gibbs sampling will be given. More complex types of models such as hierarchical models, latent class models, mixture models and state space models will be introduced and discussed. The practical sessions will follow on from day 3.
 - o General guidance for model specification.
 - o The flexibility of the BUGS language and MCMC methods.

- o The difference between informative and diffuse priors.
- o Conjugate priors and how they can be used.
- o Gibbs sampling.
- o State space models.
- o Hierarchical and state space models.
- o Latent class and mixture models.
- o Conceptual application to animal movement.
- o Hands-on application to population biology.
- o Conceptual application to epidemiology.

Day 5

- Day 5 will give some additional practical guidance for the use of Bayesian methods in practice, and finish with a brief overview of more advanced Bayesian tools such as *inla* and *stan*.
 - o Additional Bayesian methods.
 - o Understand the usefulness of conjugate priors for robust analysis of proportions (Binomial and Multinomial data).
 - o Be aware of some methods of prior elicitation.
 - o Advanced Bayesian tools.
 - o Strengths and weaknesses of Integrated Nested Laplace Approximation (INLA) compared to BUGS.
 - o Strengths and weaknesses of Stan compared to BUGS

Day 6

- Round table discussions and problem solving with final Q and A round table discussion and problem solving with final Q and A.
 - o The final day will consist of round table discussions, the class will be split in to smaller groups to discuss set topics/problems. This will include participants own data where possible. After an early lunch there will be a general question and answer time until approx. 2pm as a whole group before transport to Balloch train station.

There will be a 15 minute morning coffee break, an hour for lunch, and a 15 minute afternoon coffee break. We keep the timing of these flexible depending how the course advances. Breakfast is from 08:00-08:45 and dinner is at 18:00 each day.

Please email any inquiries to oliverhooker@prstatistics.com or visit our website www.prstatistics.com

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Upcoming PR statistics courses

1. ECOLOGICAL NICHE MODELLING USING R #ENMR

16th – 20th October 2017, SCENE, Scotland, Dr. Nefali Sillero

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2. INTRODUCTION TO BIOINFORMATICS USING LINUX #IBUL

16th – 20th October, SCENE, Scotland, Dr. Martin Jones

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3. REPRODUCIBLE DATA SCIENCE FOR POPULATION GENETICS #RDPG

23rd – 27th October 2017, Wales, Dr. Thibaut Jombart, Zhan Kavar

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4. STRUCTURAL EQUATION MODELLING FOR ECOLOGISTS AND EVOLUTIONARY BIOLOGISTS USING R #SEMR

23rd – 27th October 2017, Wales, Prof. Jarrett Byrnes, Dr. Jon Lefcheck

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5. LANDSCAPE (POPULATION) GENETIC DATA ANALYSIS USING R #LNDG

6th – 10th November 2017, Wales, Prof. Rodney Dyer

https://urldefense.proofpoint.com/v2/url?u=http-3A__www.prstatistics.com_course_landscape-2Dgenetic-2Ddata-2Danalysis-2Dusing-2Dr-2D&d=DwIF-g&c=Ngd-ta5rYsqeUsEDgxcqY1Xs5ogLxWPA_2Wlc4&r=e2OJ1azRfN8ihJzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEsJL41_7Glxe77IPUwCnRnA&s=c-vgcKont2DScy51Ty2PQ8_q0p89MMs2lp7gyod1M&e=ldng02/

6. APPLIED BAYESIAN MODELLING FOR ECOLOGISTS AND EPIDEMIOLOGISTS #ABME

20th - 25th November 2017, SCENE, Scotland, Dr. Matt Denwood

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7. INTRODUCTION TO PYTHON FOR BIOLOGISTS #IPYB

27th Nov – 1st Dec, Wales, Dr. Martin Jones

https://urldefense.proofpoint.com/v2/url?u=http-3A__www.prinformatics.com_course_introduction-2Dto-2Dpython-2Dfor-2Dbiologists-2D&d=DwIF-g&c=Ngd-ta5rYsqeUsEDgxcqY1Xs5ogLxWPA_2Wlc4&r=e2OJ1azRfN8ihJzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEsJL41_7Glxe77IPUwCnRnA&s=UhhMe7mdtnyusmy7wRiGhA9gadQaX-b98PbbGi7E1U&e=ipyb04/

8. ADVANCING IN STATISTICAL MODELLING USING R #ADVR

4th - 8th December 2017, Wales, Dr. Luc Bussiere, Dr. Tom Houslay, Dr. Ane Timenes Laugen.

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9. INTRODUCTION TO BAYESIAN HIERARCHICAL MODELLING #IBHM

29th Jan – 2nd Feb 2018, SCENE, Scotland, Dr. Andrew Parnell

https://urldefense.proofpoint.com/v2/url?u=http-3A__www.prstatistics.com_course_introduction-2Dto-2Dbayesian-2Dhierarchical-2D&d=DwIF-g&c=Ngd-ta5rYsqeUsEDgxcqY1Xs5ogLxWPA_2Wlc4&r=e2OJ1azRfN8ihJzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEsJL41_7Glxe77IPUwCnRnA&s=KrcTg1f2Zder4RcuIgoEhPkhUjuHm53PT-0qTprA&e=modelling-using-ibhm02/

10. PHYLOGENETIC DATA ANALYSIS USING R #PHYL

28th Jan – Feb 2nd 2018, SCENE, Scotland, Dr. Emmanuel Paradis

https://urldefense.proofpoint.com/v2/url?u=http-3A__www.prstatistics.com_course_introduction-2Dto-2Dphylogenetic-2Danalysis-2D&d=DwIF-g&c=Ngd-ta5rYsqeUsEDgxcqY1Xs5ogLxWPA_2Wlc4&r=e2OJ1azRfN8ihJzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEsJL41_7Glxe77IPUwCnRnA&s=vOx90HQ2sSpxXM0cPU2qfFRPKikaw513aTPXuZec&e=with-r-phyg-phy102/

11. MOVEMENT ECOLOGY #MOVE

19th – 23rd February 2018, Wales, Dr Luca Borger, Dr Ronny Wilson, Dr Jonathan Potts

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12. GEOMETRIC MORPHOMETRICS USING R #GMMR

19th – 23rd February 2018, Wales, Prof. Dean Adams, Prof. Michael Collyer, Dr. Antigoni Kalitronizopoulou

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13. FUNCTIONAL ECOLOGY FROM ORGANISM TO ECOSYSTEM: THEORY AND COMPUTATION #FEER

5th - 9th March 2018, SCENE, Scotland, Dr. Francesco de Bello, Dr. Lars Götzenberger, Dr. Carlos Carmona
https://urldefense.proofpoint.com/v2/url?u=http-3A__www.prstatistics.com_course_functional-2Decology-2Dfrom-2Dorganism-2Dto-2D&d=DwIF-g&c=Ngd-ta5yRYsqeUsEDgxcqsYYY1XsSogLxWPA_2Wlc4&r=e2OJ1azRFn8ihzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEslJL41_7Glxe77IPUwCnA&s=hPTVbmw_5kefEaQnedkgQ3Y7TTO6jW7dEpqlwOfCjI&e=ecosystem-theory-and-computation-feer01/

14. SPATIAL PRIORITIZATION USING MARXAN #MRXN

5th - 9th March 2018, Wales, Jennifer McGowan
https://urldefense.proofpoint.com/v2/url?u=https-3A__www.prstatistics.com_course_introduction-2Dto-2Dmarxan-2Dmrxn01_&d=DwIF-g&c=Ngd-ta5yRYsqeUsEDgxcqsYYY1XsSogLxWPA_2Wlc4&r=e2OJ1azRFn8ihzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEslJL41_7Glxe77IPUwCnA&s=FmqGauKP1idmFxcQabh62uzNMSboiB8-LcS2QLqjQ&e=

15. ECOLOGICAL NICHE MODELLING USING R #ENMR

12th - 16th March 2018, SCENE, Scotland, Dr. Nefali Sillero
https://urldefense.proofpoint.com/v2/url?u=http-3A__www.prstatistics.com_course_ecological-2Dniche-2Dmodelling-2Dusing-2Dr-2D&d=DwIF-g&c=Ngd-ta5yRYsqeUsEDgxcqsYYY1XsSogLxWPA_2Wlc4&r=e2OJ1azRFn8ihzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEslJL41_7Glxe77IPUwCnA&s=P2z9RRqG87ZoaUMvQ19GPTx8-PbTlelmc6C2kR5wJ8&e=enmr02/

16. BEHAVIOURAL DATA ANALYSIS USING MAXIMUM LIKLIHOOD IN R #BDML

19th - 23rd March 2018, Scotland, Dr William Hoppitt
COMING SOON www.PSstatistics.com

17. NETWORK ANALYSIS FOR ECOLOGISTS USING R #NTWA

9th - 13th April 2018, SCENE, Scotland, Dr. Marco Scotti
https://urldefense.proofpoint.com/v2/url?u=https-3A__www.prstatistics.com_course_network-2Danalysis-2Decologists-2Dntwa02_&d=DwIF-g&c=Ngd-ta5yRYsqeUsEDgxcqsYYY1XsSogLxWPA_2Wlc4&r=e2OJ1azRFn8ihzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEslJL41_7Glxe77IPUwCnA&s=TOspI4OHVgGWSs78mW4ojjR1l76KQ3Kns-5XPIN0s&e=

18. INTRODUCTION TO STATISTICAL MODELLING FOR PSYCHOLOGISTS USING R #PSY

16th - 20th April 2018, SCENE, Scotland, Dr. Dale Barr, Dr. Luc Bussierre
COMING SOON www.PSstatistics.com

19. MULTIVARIATE ANALYSIS OF ECOLOGICAL COMMUNITIES USING THE VEGAN PACKAGE #VGNR

23rd - 27th April 2018, SCENE, Scotland, Dr. Peter Solymos, Dr. Guillaume Blanchet
https://urldefense.proofpoint.com/v2/url?u=https-3A__www.prstatistics.com_course_multivariate-2Danalysis-2Dof-2Ddecological-2D&d=DwIF-g&c=Ngd-ta5yRYsqeUsEDgxcqsYYY1XsSogLxWPA_2Wlc4&r=e2OJ1azRFn8ihzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEslJL41_7Glxe77IPUwCnA&s=CBrcWVq7bGyTv2rp_Q5T2bXvL1TslE1R7F39LLxJKKU&e=communities-in-r-with-the-vegan-package-vgnr01/

20. QUANTITATIVE GEOGRAPHIC ECOLOGY: MODELING GENOMES, NICHES, AND COMMUNITIES #QGER

30th April - 4th May 2018, SCENE, Scotland, Dr. Dan Warren, Dr. Matt Fitzpatrick
COMING SOON www.PRstatistics.com

21. INTRODUCTION TO MIXED MODELS FOR ECOLOGISTS #IMMR

14th - 18th May 2018, CANADA (QUEBEC) STILL to be confirmed, Prof Subhash Lele, Dr. Guillaume Blanchet

22. STABLE ISOTOPE MIXING MODELS USING SIAR, SIBER AND MIXSIAR #SIMM

28th May - 1st June 2018, CANADA (QUEBEC) STILL to be confirmed Dr. Andrew Parnell, Dr. Andrew Jackson

23. SOCIAL NETWORK ANALYSIS FOR BEHAVIOURAL SCIENTISTS USING R #SNAR

2nd - 5th 12th July 2018, Prof James Curley
COMING SOON www.PSstatistics.com

24. MODEL BASE MULTIVARIATE ANALYSIS OF ABUNDANCE DATA USING R #MBMV

8th - 12th July 2018, Prof David Warton
https://urldefense.proofpoint.com/v2/url?u=https-3A__www.prstatistics.com_course_model-2Dbase-2Dmultivariate-2Danalysis-2Dof-2D&d=DwIF-g&c=Ngd-ta5yRYsqeUsEDgxcqsYYY1XsSogLxWPA_2Wlc4&r=e2OJ1azRFn8ihzh2HxZT0AqoiqLvxfeeTyN59ZLoI&m=CirbhikdStnlamxy09MqEslJL41_7Glxe77IPUwCnA&s=oNd86BgXm77uzLQfZAvgn_BTmuEwb2gBzCSzZB4&e=abundance-data-using-r-mbm02/

25. EUKARYOTIC METABARCODING

23rd - 27th July 2018, Wales, Dr. Owen Wangersten
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26. ADVANCES IN MULTIVARIATE ANALYSIS OF SPATIAL ECOLOGICAL DATA USING R #MVSP

Prof. Pierre Legendre, Dr. Olivier Gauthier - Date

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Oliver Hooker PhD.
PR statistics

2017 publications -

Ecosystem size predicts eco-morphological variability in post-glacial diversification. Ecology and Evolution. In press.

The physiological costs of prey switching reinforce foraging specialization. Journal of animal ecology.

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