

Rationale/Background information/Programme details etc (this info will be circulated and added to the MASTS website):

As far back as 1969 the Canadian ecologist Evelyn Pielou was able to write that “ecology is essentially a mathematical subject”. Since then, mathematical and statistical models have increased their influence, and they feature in almost all areas of marine ecology and environmental science. Many recent and current Research Council initiatives, for example, contain major modelling elements, including those in the Marine Ecosystems, Ocean Acidification, Biodiversity and Ecosystem Service Sustainability, and the Arctic Research Programmes.

Nevertheless, postgraduate students and early career researchers engaged in empirical science still often struggle with using models in their research, or even with thinking about how their data can be used as part of modelling projects. NERC has identified mathematical modelling and statistics as one of their Headline Skills gaps.

The workshop will offer a short practical introduction to two broad classes of models – dynamical systems and Bayesian modelling – with very wide applicability to marine ecology. The aims are twofold. Firstly, the workshop will expose the participants to a ‘taster menu’ of leading-edge mathematical and statistical methods in order to demonstrate that building models purpose-built for your own research is less difficult than it might seem at first. Secondly, it will bring together experimentalists and modellers with a view to increasing collaboration within the MASTS community.

The workshop will draw on multidisciplinary expertise of tutors in the Strathclyde University Department of Mathematics and Statistics, and is a joint event with Statistics and Advice Research and Training (SMART) and the Centre for Mathematics Applied to the Life Sciences (CMALS). There will be two sessions covering dynamical systems and Bayesian modelling, and participants are welcome to attend either or both of these. In both cases the format will be a combination of short presentations by the workshop leaders together with guided practical sessions in which the participants will have the opportunity of running the models on their laptops and generating their own outputs first hand. Registered participants will be sent information on how to obtain the appropriate software.

Session 1: Dynamical systems: Build your own models in R. This course will ‘lift the lid’ on ordinary differential equations (ODEs) used to model processes in the environmental sciences. The emphasis will be on careful model formulation and practical numerical implementations. Drawing on examples from simple predator-prey interactions through to realistic ecosystem models, we will illustrate the formulation of problems as dynamical systems, and show how these can be coded and solved using the open-source, well supported, and widely used programming environment R.

Session 2: Bayesian methods to fit statistical models. Bayesian model fitting methods will be introduced and compared to classical approaches, and we will demonstrate how to set up models where Bayesian methods are necessary. The OpenBUGS statistical package will be

used in conjunction with R for practical sessions. The focus will be on applications and modelling, but will also explain the basic underlying concepts.

www.strath.ac.uk/science/mathematicsstatistics/
www.strath.ac.uk/science/mathematicsstatistics/workingwithus/
www.gla.ac.uk/research/az/cmals/

Provisional Workshop Outline

Session 1 – Dynamical systems: Build your own models in R

Douglas Speirs, Michael Heath, Nigel Mottram, Juan Bonachela

09:30 – 10:30 Welcome

 What are dynamical systems?

 Getting started with some simple models

10:30 – 11:00 Coffee break

11:00 – 12:30 Practical Session with more realistic models

12:30 – 13:30 Lunch

Session 2 – Bayesian methods to fit statistical models

Robin Cook and TBA

13:30 - 14:30 A Gentle Introduction to Bayesian Statistics

14:30 - 15:30 Practical Session

15:30 – 16:00 Coffee break

16:00 – 16:30 Discussion

Expected Outcomes/Outputs:

The workshop will expose the participants to ‘taster menu’ of models and their uses, and demonstrate that getting started with basic, but leading-edge, mathematical and statistical models is less difficult than it might seem at first. It will bring together experimentalists and modellers with a view to increasing collaboration within the MASTS community.