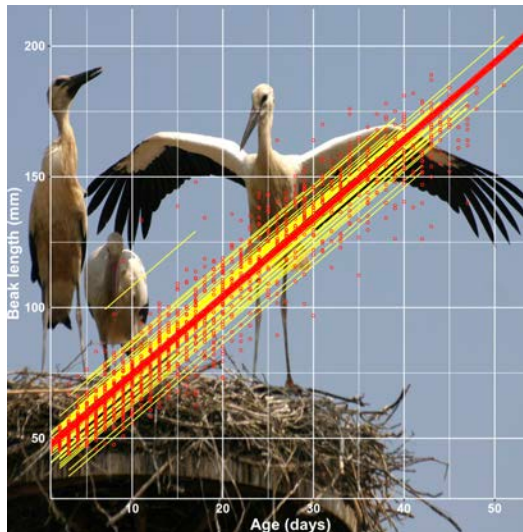


# Introduction to Linear Mixed Effects Models and GLMM with R-INLA

Presented by: Highland Statistics Ltd.

Organised by: Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada.

(Andrew Cuff, Andrew.Cuff@dfo-mpo.gc.ca)



## Dates & Venue

Dates: 12 - 16 August 2019

Venue: Northwest Atlantic Fisheries Centre, St John's, Canada

Price: 950 CAD + 15% GST

Instructors: Dr. Alain Zuur  
Dr. Elena Ieno

Authors of 10 books and presenters of over 300 courses worldwide.

The course begins with a brief revision of multiple linear regression, followed by an introduction to Bayesian analysis and how to execute regression models in R-INLA. We then explain linear mixed effects models to analyse nested data, followed by a series of mixed modelling exercises in R-INLA. Nested data means multiple observations from the same animal, site, area, nest, patient, hospital, vessel, lake, hive, transect, etc.

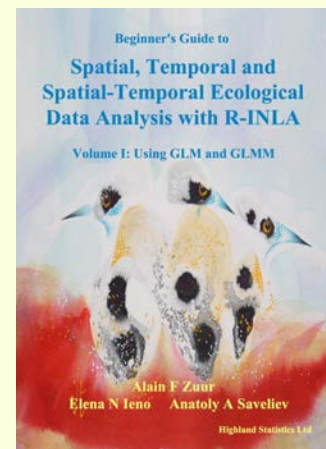
In the second part of the course GLMMs are applied on count data, binary data (e.g. absence/presence of a disease), proportional data (e.g. % coverage) and continuous data (e.g. biomass or distance) using the Poisson, negative binomial, Bernoulli, binomial, beta and gamma distributions.

In the third part of the course we show how R-INLA can be used to execute GLMs with temporal dependency for the analysis of univariate and multivariate time series.

We will use R-INLA.

## KEYWORDS

Revision regression and GLM. Introduction to linear mixed effects models and GLMM. Dealing with pseudo-replication and dependency. Nested data. Longitudinal data. INLA. Bayesian analysis. Time series and GLM.



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## COURSE CONTENTS

### Monday

- Brief revision of multiple linear regression in R
  - One exercise
  - Introduction to matrix notation
- Brief introduction to Bayesian analysis
  - Conjugate priors
  - Diffuse versus informative priors
- Brief theory presentation on INLA
  - Exercise how to fit a regression model in R-INLA

### Tuesday

- Theory presentation on linear mixed effects models
- Two exercises showing how to apply linear mixed effects models in R-INLA
  - Random intercept and slope models
  - Sketching fitted values

### Wednesday

- Using multiple variances (GLS) in R-INLA
  - One exercise
- Brief revision GLM
  - One exercise showing how to execute a Poisson GLM and negative binomial GLM in R-INLA
- Three GLMM exercises in R-INLA
  - Poisson GLMM
  - Negative binomial GLMM
  - Poisson and negative binomial GLMMs with two-way nested and crossed random effects

### Thursday

- A series of exercises covering the applications of Bernoulli, binomial, gamma and beta GLMMs in R-INLA

### Friday

- Theory presentation on temporal trends and residual auto-correlation
  - Two exercises showing the analysis of (univariate and multivariate) time series using GLMs in R-INLA
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## GENERAL INFORMATION

### COURSE FEE: 950 CAD + 15% GST

Credit card payments are charged in CAD currency.

### COURSE TIMES:

- Monday-Thursday: 09.00am to 16.00pm.
- Friday: 09.00am to 12.00pm.
- 1-hour lunch and a 20-minute break, both morning and afternoon. There will be no lunch on Friday.

### COURSE MATERIAL:

- Pdf files of all powerpoint presentations are provided.
- These powerpoint files are based on various chapters from:
  - Zuur, Ieno, Saveliev (2017). *Beginner's Guide to Spatial, Temporal and Spatial-Temporal Ecological Data Analysis with R-INLA*.
  - This book is not included in the course fee. The course can be followed without purchasing this book.

### PRE-REQUIRED KNOWLEDGE:

Working knowledge of R, data exploration, linear regression and GLM (Poisson, negative binomial, Bernoulli). This is a non-technical course.

### CANCELLATION POLICY:

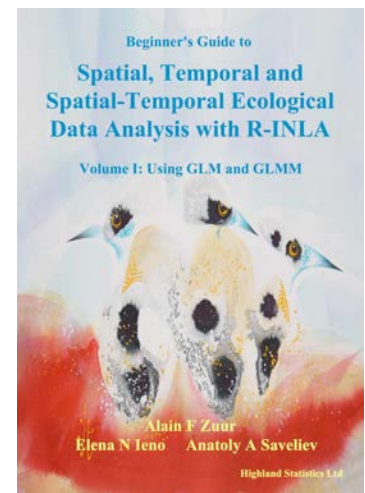
What if you are not able to participate? Once participants are given access to course exercises with R solution codes, pdf files of certain book chapters, pdf files of powerpoint files and video solution files, all course fees are non-refundable. However, we will offer you the option to attend a future course or you can authorise a colleague to attend this course. For terms and conditions go to: <http://highstat.com/index.php/sign-up2>.

### RECOMMEND LITERATURE:

- Zuur, Ieno, Saveliev (2017). *Beginner's Guide to Spatial, Temporal and Spatial-Temporal Ecological Data Analysis with R-INLA*.
- This book is available from [www.highstat.com](http://www.highstat.com).

### GENERAL

- You need to bring your own laptop.
  - Please ensure that you have system administration rights to install R and R packages on your computer.
  - Instructions for what to install will be provided before the start of the course.
- You will be given access to a course website with around 25 fully worked-out R exercises. These are all based on published papers and real data sets.



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## REGISTRATION

[www.highstat.com](http://www.highstat.com)

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Payment via credit card or bank transfer

