Mixed-Effect Models for Forest Applications with Examples in R (3 ECTS)

Description

Mixed-effect modelling is important for modelling based on data with various kinds of grouped structures. Examples include data from clustered sample plots in forest inventories, longitudinal data where observations have been made on the same objects at repeated occasions, and hierarchical data structures where, e.g., trees on plots are the study objects. Similar data structures are also common in other disciplines than forest inventory. The effect of groups can be modelled either fixed or random. The core of expected learning outcomes is which effect to choose in the modelling approach. This course provides an introduction to the mixed-effect modelling theory starting with a theory on modelling with categorical variables through generalized linear mixed-effect modelling when non-gaussian assumptions are employed. The course gives examples of practical usage and intuition on to how the modelling methods are applied.

Upon successful completion of the course, participants will be able to understand general concepts of regression analysis with grouped data. The course is intended for students and researchers in ecology, natural resources, forestry, agriculture and environmental sciences.

The course will include the pre-course self-study through literature reading, and the post-course home exam.

- Pre-course assignment 10 hours
- Working in the class 35 hours
- Home exam after the course 30 hours

Expected number of participants in the course is 30 students.

The language is English.

Contents

- Working with categorical data
- Linear mixed-effect models
- Mixed or random effects: which to apply
- Non-linear mixed-effect models
- Generalized linear mixed-effect models

Time

May 19th – 23rd, 2025

Detailed plan for the course

Monday, May 19th:

9:00 – 12:00: Introduction to the course. A brief review of OLS regression and the use of dummy variables (chapter 4 from the course textbook).

12:00 – 13:00: Lunch

13:00 – 15:30: Exercises

Tuesday, May 20th:

9:00 – 12:00: Linear mixed-effects models (chapters 5 and 6)

12:00 – 13:00: Lunch

13:00 – 15:30: Exercises

Wednesday, May 21st:

9:00 – 12:00: Generalized linear mixed-effects models (chapters 2 and 8)

12:00 – 13:00: Lunch

13:00 – 15:30: Exercises

Thursday, May 22nd:

9:00 – 12:00: Nonlinear (mixed-effects) models (chapter 7), presented by Prof. Lauri Mehtätalo (open for everyone to join).

12:00 – 13:00: Lunch

13:00 – 15:30: Exercises

16:00 – 19:00: Social event

Friday, May 23rd:

9:00 – 12:00: "Mixed or Random Effects: Which to Apply?" Workshop (Prof. Lauri Mehtätalo and Prof. Emma Holmström will join the workshop).

12:00 – 13:00: Lunch

13:00 Course conclusion, travel back home

Learning outcome

Knowledge and understanding

1. outline general concepts of modelling with grouped data sets;
2. explain a difference between random and fixed effects;
3. perform regression analysis applying linear mixed-effect models, nonlinear mixed effect models, and generalized linear mixed-effect models.

Skills and abilities

4. regression analysis with grouped data.

Pedagogical approach

The course will consist of lectures mixed with exercises. In the end of the course, students will be given the home exam tasks, which should be seen as a repetition of previously given material.

Evaluation elements

The grading for the course is *Pass / Fail*.

Credits

3 ECTS

Attendants

The course is primarily intended for PhD students, but post-doctoral researchers are also welcome to attend.

Location

NMBU, Ås, Norway

Literature

Mehtätalo,L. & Lappi, J. (2020). *Biometry for forestry and environmental data: With examples in R.* CRC press.

Software

The course will be based on R statistical software.

Computers

The computer exercises will be done in the lecture room using private laptop computers.

Prerequisites

It is recommended that participants have a basic knowledge in regression analysis and statistics, e.g. acquired through participation in a basic course at the Master level.

As a prerequisite, students must complete an exercise based on ordinary least squares (OLS) regression analysis using the provided data by May 16th. The exercise will be distributed on May 12th. The recommended reading includes Chapter 4 of *Biometry for Forestry and Environmental Data: With Examples in R* by Lauri Mehtätalo and Juha Lappi. Additionally, videos 1 through 12 from the *Analysis of Grouped Data* course, taught online by Prof. Lauri Mehtätalo, may also be helpful. The full course (53 videos) can be accessed through the following link:

https://www.youtube.com/watch?v=CVKtS7YOu5I&list=PLLiSq4pLlOEAdRBfDAqVC3B1mXe9M_Bja&index=1

Teachers

Svetlana Saarela, PhD, (NMBU)
Lauri Mehtätalo, Research Professor, (LUKE)
Emma Holmström, Professor, (SLU)