**Linear Models Course Schedule 2021**

**Instructors: Kyle Tomlinson, Huan Fan**

**Dates: 14 – 19 June (6 days)**

This is an advanced course, so there are certain pre-requisites for admission.

(1) Participants should have seen at least one semester of statistics at university or college. Students who have completed the AFEC stats module will also be considered.

(2) Participants should be familiar with R. Students familiar with S and SAS may also apply.

Please provide evidence in line with each of these requirements when applying for the course.

The course is divided into a series of modules that build on each other towards more complex linear models, starting from simple linear models and generalised linear models, to mixed effects models with grouped random effects, and linear models with generalised least squares for random effects that cannot be grouped. The underlying linear models are explained so experience with linear algebra will be very helpful though not essential to complete the course.

**Module 1: Classical methods (~ 1 day)**

Lectures 1, 2

The first day revises basic statistical concepts and classical methods, and links them via the linear model and the generalised linear model.

**Module 2: Modelling with grouped non-independent data: mixed effects models for grouped random factors (~ 2.5 days)**

Lectures 3, 4, 5, 6, 7

This section introduces the problem of non-independent data and how to fix it appropriately using linear models. Here we introduce concepts of fixed and random effects and how they can be combined in mixed effect model (MM) formulations of the general linear model. At this stage we deal only with **grouping** random effects.

**Module 3: Modelling with non-independent data that cannot be grouped: covariance matrix methods (~2 days)**

Lectures 8, 9, 10,11

Certain types of data are non-independent, but the non-independence cannot be corrected by grouping, e.g. autocorrelation in spatial and temporal data, which depend on individual pairwise distances between data units. These can be dealt with by incorporating covariance matrices into the calculations. In this module we introduce two methods for dealing with this: generalised least squares (GLS) and an extended MM called the animal model. Because of limits on available software in R for the animal model, we will use Bayesian formulations and software. Therefore, we will also include a brief intro to Bayesian philosophy and considerations for Bayesian analyses here.

**DAY 1**

Lecture 1: Linear models

Prac 1: Linear models

Lecture 2: Generalised linear models

Practical 2: Generalised linear models

**DAY 2**

Lecture 3: Intro to Mixed effects models

Practical 3: Intro to Mixed effects models

Lecture 4: Linear mixed models

Practical 4: Linear mixed model types

Lecture 5: Inference with LMMs

Practical 5: Inference with MMs

**DAY 3**

Lecture 6: Predictions with LMMs

Practical 6: Predictions with LMMs

Lecture 7: GLMMs

Practical 7: GLMMs

**DAY 4**

Lecture 8: Generalised least squares

Practical 8: Generalised least squares

Lecture 9: Phylogenetic regression using GLS

Practical 9: Phylogenetic regression using GLS

**DAY 5**

Lecture 10: Covariance models for non-normal data

Practical 10: Covariance models for non-normal data

**DAY 6**

Lecture 11: Bayesian philosophy and modelling considerations

Practical 11: Bayesian modelling

Final day: Play with your own data (if there is time)

PLEASE INSTALL THE FOLLOWING PACKAGES FOR R

library(ggplot2)

library(AER)

library(COMPoissonReg)

library(nlme)

library(lme4)

library(lmerTest)

library(sjPlot)

library(lattice)

library(arm)

**library(utils)**

library(car)

library(MuMIn)

library(pbkrtest)

library(verification)

library(ape)

library(phylolm)

library(phytools)

library(picante)

library(caper)

library(brms)

library(gstat)

library(sp)

library(tidyverse)

library(gridExtra)

library(DHARMa)

library(spaMM)

Please note that this is not an exhaustive list, and we may request you to add more packages during the course.