## Workshop 2 (Pre-conference)

Title: A modern application of linear mixed models with case studies.
Date: Saturday, December 3, 2011 (9:00am-5:00pm)
Place: Building 67, Room 203, University of Wollongong  (nearest carpark is P5 on map)
Registration desk from 8:15am. Course starts 9:15am. See programme below
See the Appendix (in this document) for a map of the McKinnon Building (67) and the University map (Entry near telephone on map)
http://www.uow.edu.au/content/groups/public/@web/@unia/documents/doc/uow029186.pdf

Presenter:  Professor Brian Cullis (University of Wollongong and CSIRO)
Co-presenters: Dr David Butler (Queensland Department of Department of Employment, Economic Development and Innovation) and Dr Julian Taylor (University of Adelaide)

*Overview*
Linear mixed effects models provide a rich and flexible tool for the analysis of many data-sets commonly arising in the agricultural, biological, medical and environmental sciences. Typical applications include the analysis of balanced and unbalanced longitudinal data, repeated measures, balanced and unbalanced designed experiments, multi-environment trials, multi-centre trials, multivariate datasets and regular or irregular spatial data.

Consistent with the themes of this conference we will present the analysis of three examples taken from plant genetics (2) and environmental applications. The analysis will be undertaken within the R platform of the ASReml software (known as ASReml-R) and will showcase new theoretical approaches as well as new features of the software which allow novel and complex modelling of the variance structure of composite terms in the linear mixed model. Equivalent scripts will be available for the standalone version of ASReml.

The workshop will commence with a basic presentation of the linear mixed model within the ASReml family. In particular, our focus will be on the development of a general syntax for specification of extended variance models for single and composite terms in the random component of the linear mixed model.  Following this we will then present a detailed description of the each of the motivating data-sets, and the aim(s) of the analyses.

i.   The first example will consider the analysis of partial composited data sets with applications to field trials and spatial environmental data-sets. The approach is presented in A.B. Smith *et al*. (2011) We will also illustrate the use of the R package OD (Optimal Design) for the design of partiallly composited field trials and multi-phase designs.

ii.  The second example will illustrate advanced QTL mapping approaches using the WGAIM package. This package uses sophisticated mixed modelling approaches for detecting QTLs. It is novel in the sense that it uses a whole genome interval mapping approach embedded within the linear mixed model, hence allowing for simultaneous modelling of non-genetic and polygenic variation in a one-stage analysis. It is also easily extended to handle multivariate and multi-environment data sets.

iii. Thirdly, we will also consider the implementation of so-called fixed rank kriging (Cressie and Johannesson, JRRS(B) 2008) in ASReml-R. The ideas will be illustrated using a precision agriculture data set.

Additional theory relevant for the analysis of each example will also be presented as required. Each analysis will be undertaken using live demonstrations of the software but we will also offer the opportunity for hands-on analysis.

**Format:** A mixture of lecture-style presentations blended with hands-on tutorial sessions. The presenters will supervise each of the tutorial sessions. This will allow participants to become familiar with the ASReml-R syntax, as well as the underlying theory.

References:

- ASReml-R user guide
- www.mmontap.org
- A.B. Smith, R. Thompson, D.G. Butler, and B.R. Cullis (2011) *The analysis of variety trials using mixtures of composite and individual plot samples*. Journal of the Royal Statistical Society, Series C, 60:437–455.
- Cressie, N. and Johannesson, G. (2008). Fixed rank kriging for large spatial datasets. Journal of the Royal Statistical Society, Series B, 70, 209-226.

**<u>Pre-requisites for workshop</u>**: This is a practical workshop and you are allowed to bring your own laptop for the Windows platform (32-bit or 62bit personal computers) only. We suggest that people share for optimal benefit of the course (2 to a laptop) and also to minimise the number of power cords floating around the room.

You should download and install the following software before the course. Assistance will be provided at the course should you encounter any problems with installation.

- R Statistical System. Go to http://www.r-project.org and download the latest version of R (R-2.14.0) for Windows. Run the setup file. All users must have the latest version on their computers.
- Download the latest asreml and wgaim packages ('.zip' files) for Windows platform. Go to http://www.mmontap.org and under the download menu item, download these R packages.
- Follow the link on the 'wgaim' package and download the 'qtl' package for Windows from CRAN. Save the '.zip' file for Windows platform.
- RStudio (available from http://www.Rstudio.org)

Installation of the above R packages can be done via RStudio or via the R program itself.

**Programme**
*8: 15am- Registration, checking laptops and installation if required with appropriate files and software*

(All sessions will be a mix of lectures and hands-on tutorials built around scripts and (mostly) real data sets.)

**9:15am – 10.30am SESSION 1:**
Part1 – Overview and motivating examples for the AM component: Brian
Part 2 – Optimal Design (OD) for linear mixed models: David

**10.30 am – 11.00 am**  Morning tea

**11.00 am – 12.30 pm SESSION 2:**
Design and analysis of multi-phase experiments with a mixture of composite and individual samples: Brian and David

**12.30 pm – 1.30 pm** Lunch

**1.30 pm – 3.00 pm SESSION 3:**
Advanced QTL mapping approaches using the WGAIM:  Julian

**3.00 pm – 3.30pm** Afternoon tea

**3.30pm – 4.30pm SESSION 4:**
 Part1 - Further topics in QTL analysis: Julian
Part2 - Low rank kriging & Q&A session: Brian, David and Julian

**5.00 pm Close**

**Course notes**
A small booklet with minimal notes will be provided to save the TREES! A complimentary USB stick will be provided with all of the course materials, software, R scripts and data sets.

*Last updated November 27, 2011. BC-DB-JT&MD*

**Appendix 1: McKinnon Building 67**