

Module 2: Linear mixed effect models in R

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In many research fields (medical sciences, biological systems, physical and social sciences, etc.), study designs lead to different kinds of data sets. These include (i) clustered data, such as experimental designs with random blocks, and (ii) repeated-measures data, in which individuals are measured repeatedly under different conditions. For example, the Rat Pup data is a two-level clustered data set obtained from a cluster randomized design: each litter (cluster) was randomly assigned to a specific level of treatment (high, low and control dose treatments), and rat pups (units of analysis) were nested within litters. The birth weights of rat pups within the same litter are likely to be correlated because the pups shared the same maternal environment. The investigators were interested in studying whether the birth weights of pups from litters born to female rats that received the high- and low-dose treatments differ to the birth weights of pups from litters that received the control treatment. Linear mixed effects models are statistical models developed with powerful and flexible analytic tools to appropriately analyse such data. However, misspecification of the types of factors (fixed, random or nested) and misuse of software procedures or functions implies misleading results from statistical modelling and erroneous conclusions. So, an efficient data analysis requires a good specification of factors and subsequently the model structure which often is not straightforward for non-specialists. Moreover, easiness of least square means (lsmeans) computation allows a well explanation of factors effects than common arithmetic means under mixed models framework.

During this module, main emphasis will be put on the principles and applications of mixed effects models. The main points to cover include:

- Type and structures of datasets
- Type of factors and their related effects
- Model specification
- Applications in R : two and three levels data analysis

Scientific report of linear mixed effects models data analyses