A practical GLMM example: Network meta-analysis of studies of binary outcomes – occurrence of exacerbations in COPD patients

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We investigate the information on the relative effectiveness of several treatments in a network, so that all treatment contrasts can be analysed in one model, including direct as well as indirect evidence[1]. The example is a network of 5 inhalative treatments, investigated in double-blind trials, in patients with Chronic Obstructive Pulmonary Disease (COPD): Tiotropium (a long-acting anticholinergic), Salmeterol, Indacaterol, Formoterol (3 long-acting β_2-agonists), and placebo. The selection of studies has been described recently[2]. All trials lasted minimally 24 weeks and maximally 1 year. The binary endpoint is the occurrence of at least 1 exacerbation of the COPD during the trial.

The GLMM for the proportion π of patients with event on treatment *i* in study *k* and arm *ik* is

$$\text{Logit}(\pi_{ik}) = \tau_i + \mu_k + a_{ik}$$

with μ_k fixed for all *k*, τ_i fixed for all *i*, $a_{ik} \sim N(0,\sigma^2)$, $\tau_1=0$ (Placebo) and $\mu_1=0$ (Study 1).

Treatment contrasts can then be estimated through this common model for all 5 treatments. In total, 31 trial arms are included.

We compare the classical frequentist method[1], the MCMC method as implemented in WinBUGS[3], and, as deterministic-numerical approximation to the distribution of treatment contrasts, the Integrated Nested Laplace Approximation (INLA) method[4]. We investigate here in particular the goodness of the approximation. We show also an intuitive graphical result summary[5]. In this example the medical results did not differ by much. This was valid for the treatment differences as well as for the ordering of the treatments.

References:
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