Chapter 5

Modeling and inference using GLMMs

5.1 Introduction

In this chapter I continue the prescription of Section 4.4 and present a number of examples and consider the inferential goals.

5.2 Chestnut blight (gene effects)

Recall the model we developed in the first chapter (1.1) for the chestnut blight example, now modified to include random effects:

$$
\begin{aligned}
&Y_i = 1 \qquad \text{if the virus is transmitted and 0 otherwise,} \\
&Y_i|\mathbf{u} \sim \text{indep. Bernoulli}(p_i), \\
&p_i = \Phi\left(\mu + \sum_s \beta_s \text{MCH}_{is} + \sum_s \gamma_s \text{ASY}_{is} + \mathbf{z}'_{d,i}\mathbf{u}_1 + \mathbf{z}'_{r,i}\mathbf{u}_2\right),
\end{aligned} \tag{5.1}
$$

where $\mathbf{z}'_{d,i}$ and $\mathbf{z}'_{r,i}$ are the ith rows of the model matrices for the donor and recipient random effects, respectively, and we assume

$$
\begin{aligned}
&\mathbf{u}_1 \sim \mathcal{N}(0, \mathbf{I}\sigma_d^2) \ \text{ independent of} \\
&\mathbf{u}_2 \sim \mathcal{N}(0, \mathbf{I}\sigma_r^2).
\end{aligned} \tag{5.2}
$$

One inferential goal might be to test if gene 4 had an effect. To do so we could fit the model described by (5.1) and (5.2) and evaluate the log likelihood. We would next fit the same model, but with β_4 and γ_4 set equal to zero and compare the value of the log likelihood. A large sample likelihood ratio test could be used to test $H_0 : \beta_4 = \gamma_4 = 0$. The inferential goal in this case is to form a hypothesis test of parameters from the linear predictor.