# Chapter 5
# Computational Methods for Mixed Models

$$\mathrm{Var}(B) = \mathrm{E}\left[(B -\right.$$

we would first determine the joint density of $U$ 7(y)-363n63(8 9.9626 Tf 199.196 0.60457(y)-36

$$\tilde{\mathrm{u}} = \arg\max_{\mathrm{u}} f_{U|Y}$$

### *5.4.1 The Fill-reducing Permutation,* P

In earlier chapters we have seen that often the random e□ects vector is re-ordered before $L_\theta$ is created. The re-ordering or permutation of the elements of u

matrix being decomposed. However, as we saw in Fig. 2.4 of Sect. 2.1.2, there may be positions in the factor that get filled-in even though they are known

~

become computationally singular in ill-conditioned problems, in which case an error is reported.

It is not entirely clear how one would define a "REML estimate" of $\beta$ because

To update the matrix $\Lambda_\theta$ to a new value of $\theta$ we need to know which of the non-zeros in $\Lambda$ are updated from which elements of $\theta$. Recall that the

where $k$ is the step factor chosen, perhaps by step-halving [Bates and Watts, 1988, Sect. 2.2.1], to ensure that the penalized residual sum of squares decreases at each iteration. Convergence is declared when the orthogonality convergence criterion [Bates and Watts, 1988, Sect. 2.2.3] is below some prespecified tolerance.

The *Laplace approximation* to the deviance is

$$d(\theta, \beta, \sigma | \mathrm{y}_{\mathrm{obs}}) \approx = n$$

## Exercises