A.2 Block-diagonal Hessian

This section contains models with grouped or nested random effects

A.2.1 Nonlinear mixed models; a NLME comparison

Model description The orange tree growth data was used by Pinheiro & Bates (2000, Ch.8.2) to illustrate how a logistic growth curve model with random effects can be fit with the S-Plus function nlme. The data contain measurements made at seven occasions for each of five orange trees:

- \( t_{ij} \) Time point when the \( j \)th measurement was made on tree \( i \)
- \( y_{ij} \) Trunk circumference of tree \( i \) when measured at time point \( t_{ij} \)

The following logistic model is used:

\[
y_{ij} = \frac{\phi_1 + u_i}{1 + \exp\left[-\left(t_{ij} - \phi_2\right)/\phi_3\right]} + \varepsilon_{ij},
\]

where \((\phi_1, \phi_2, \phi_3)\) are hyper-parameters, and \(u_i \sim N(0, \sigma_u^2)\) is a random effect, and \(\varepsilon_{ij} \sim N(0, \sigma^2)\) is the residual noise term.

Results Parameter estimates are shown in the following table.

<table>
<thead>
<tr>
<th></th>
<th>(\phi_1)</th>
<th>(\phi_2)</th>
<th>(\phi_3)</th>
<th>(\sigma)</th>
<th>(\sigma_u)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADMB-RE</td>
<td>192.1</td>
<td>727.9</td>
<td>348.1</td>
<td>7.843</td>
<td>31.65</td>
</tr>
<tr>
<td>Std. dev.</td>
<td>15.658</td>
<td>35.249</td>
<td>27.08</td>
<td>1.013</td>
<td>10.26</td>
</tr>
<tr>
<td>nlme</td>
<td>191.0</td>
<td>722.6</td>
<td>344.2</td>
<td>7.846</td>
<td>31.48</td>
</tr>
</tbody>
</table>

The difference between the estimates obtained with ADMB-RE and nlme is small. The difference is caused by the fact that the two approaches use different approximations to the likelihood function. (ADMB-RE uses the Laplace approximation, and for nlme the reader is referred to (Pinheiro & Bates 2000, Ch. 7).)

The computation time for ADMB was 0.58 seconds, while the computation time for nlme (running under S-Plus 6.1) was 1.6 seconds.

Files http://otter-rsch.com/admbre/examples/orange/orange.html
Bibliography

ADMB Development Core Team (2009), *An Introduction to AD Model Builder*, ADMB project.


