WinBUGS Example - Mice: Weibull regression in censored survival analysis

Sudipto Banerjee
Division of Biostatistics, University of Minnesota
September 13th, 2010

Data set

Data Set: Photocarcinogenicity study from Grieve(1987)
80 mice divided equally in 4 groups: irradiated control, vehicle control, test substance and positive control;
The data contains the survival time (weeks) and whether the mice died or were censored at that time.

<table>
<thead>
<tr>
<th>Mouse</th>
<th>Irradiated control</th>
<th>Vehicle control</th>
<th>Test substance</th>
<th>Positive control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>*40</td>
<td>30</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>19</td>
<td>31</td>
<td>37</td>
<td>37</td>
<td>17</td>
</tr>
<tr>
<td>20</td>
<td>36</td>
<td>27</td>
<td>29</td>
<td>26</td>
</tr>
</tbody>
</table>

where * indicates censoring.

Statistical Model

Weibull Regression

- $t_i \sim Weibull(r, \mu_i)$, where $t_i$ is the failure time of an individual with covariate vector $x_i$;
- $\mu_i = \exp(\beta x_i)$ and $\beta$ is a vector of unknown regression coefficients;
- The baseline hazard function is of the form: $\lambda_0(t_i) = rt_i^{r-1}$;
- For censored observations the survival distribution is a truncated Weibull, with lower bound corresponding to the censoring time.

Weibull Regression (contd.)

- The regression $\beta$ coefficients were assume a priori to follow independent Normal distributions with zero mean and "vague" precision 0.0001;
- $r \sim Gamma(1, 0.0001)$.

Graphical model for the mice example