Random effects ordinal/discrete time models: Application to grouped toxicological data

Martinez M.-J.[1] & Hinde J.[1]

[1] National University of Ireland, Galway, Ireland

Discrete survival times can be considered as ordered multicategorical data. In the ordinal data modelling context, a variety of multinomial regression models can be used. We consider here a continuation-ratio model, which is particularly appropriate when the ordered categories represent a progression through different stages, such as survival through various times. When we have replicated data we can incorporate random effects into the linear predictor of the model to account for uncontrolled experimental variation (this may be apparent through overdispersion of multinomial responses across the replicates). Here we extend the continuation ratio model to include both a random intercept and random slope. Assuming normal distributions for the random effects we use adaptive Gaussian quadrature in an EM algorithm to estimate the model parameters. We explore the advantages of adaptive quadrature in this situation and also consider the use of discrete mixing distributions to remove the specific distributional assumptions on the random effects.

To illustrate the interest of this approach, we will describe a data analysis from a biological control assay where different isolates of a fungus are used as a microbial control for termites. Each isolate is applied to several groups of termites and the cumulative mortality in each group is measured at various time points in order to study the pathogenicity and virulence of this fungus. We consider the application of the continuation ratio random effects models and compare this with other extended ordinal multinomial models, such as the Dirichlet-multinomial.