Multi-level survival analysis in practice

Stryhn, H.[1], Elghafghuf, A.[1], Burnley, T.A.[1,2] and Hammell, K.L.[1,2], [1]Atlantic Veterinary College, University of Prince Edward Island, Centre of Veterinary Epidemiological Research, Canada, [2]Atlantic Veterinary College, University of Prince Edward Island, AVC Centre for Aquatic Health Sciences, Canada;
hstryhn@upei.ca

The inclusion of random effects (frailties) in survival analysis has become a standard approach to account for hierarchical, or multi-level, data structures. It is however less common to include other components of multi-levels models, namely random regression coefficients (also called random slopes) and contextual effects. This may be due both to the computational complexity of the former and to the scarcity of datasets that support such modelling. We use a previously published analysis of data on lameness in piglets, with sows clustered in herds, to illustrate the additional insights that may be obtained from a full multi-level survival analysis based on the Cox proportional hazards model, and how such insights may substantially affect study conclusions. Our analysis includes a simulation study to compare the performance of four estimation approaches for Cox models with correlated frailties available in standard software, with ensuing recommendations for choice of analytical approach and software. As a second example we consider mortality data from a recent aquaculture field vaccine trial carried out with individually tagged fish in multiple cages each comprising multiple vaccine groups simultaneously (2). We discuss the challenges of a full multi-level survival analysis to account for cage-level variations in vaccine effects within a hierarchy with sparse replication at the upper (cage) level.