Reduced rank proportional hazards models for competing risks

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Multiple events concerning individual subjects are of interest in many medical studies. This is true in particular for breast cancer trials where after the appearance and the successful treatment of the first diagnosed tumour patients are at risk of recurrence and death. The recurrences are often classified as local or distant (metastasis in distant sites). In this framework competing risks models that model several competing causes of therapy or surgery failure are a natural framework to describe the evolution of the disease. These models have one transient state 0: alive and event-free and a number of absorbing states, state k, k = 1, ..., K, corresponding to event from cause k. In most breast cancer trials, data is recorded for each individual on a number of covariates. In the competing risks context, two extreme approaches are most often used to model the effect of these covariates on the transition times. The first is a stratified proportional hazards model, where the effect of the covariates is assumed to be identical for each of the transitions. The second is one where for each transition a proportional hazards model is assumed. Clearly, the second approach will result in a better fit to the data; on the other hand it uses many parameters and has the danger of over-fitting. We propose to model the hazard rate $h_k(t)$ for transition k at time t for an individual with vector of covariates Z in the following way $h_k(t) = h_{k0}(t) \exp(c_k\ bZ)$. In this model all covariates have the same effect on all transitions apart from the proportionality coefficient c_k. We will study estimation in this model and illustrate its use on real data. We will also discuss its (dis)advantages and propose extensions to higher rank.