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Phase-type models for competing risks

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A phase-type distribution can be defined to be the distribution of time to absorption for an absorbing finite state Markov chain in continuous time. Phase-type distributions have received much attention in applied probability, in particular in queuing theory, generalizing the Erlang distribution. Among other applications, they have for a long time been used in reliability and survival analysis. Particular interest has been in the use of so-called Coxian phase-type models. Their usefulness stems from the fact that they are able to model phenomena where an object goes through stages (phases) in a specified order, and may transit to the absorbing state (corresponding to the event of interest) from any phase. It is noteworthy that Coxian phase-type models have recently, in a number of papers, been successfully applied to model hospital length of stay in health care studies. These authors typically claim the superiority of Coxian phase-type models over common parametric models like gamma and lognormal for this kind of data. Similar models are apparently appropriate for reliability modeling of complex degrading systems.

The main purpose of the present talk is to study how the phase-type methodology can be modified to include competing risks, thereby enabling the modeling of failure distributions with several failure modes, or, more generally, event histories with several types of events. One then considers a finite state Markov chain with more than one absorbing state, each of which corresponds to a particular risk. Standard functions from the theory of competing risks can now be given in terms of the transition matrix of the underlying Markov chain. We will be particularly concerned with the uniqueness of parameterizations of phase-type models for competing risks, which is of particular interest in statistical inference. We will briefly consider maximum likelihood estimation in Coxian competing risks models, using the EM algorithm. A real data example will be analyzed for illustration.

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