

# Modelling imperfect maintenance and repair of components under competing risk

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## Abstract

We investigate the mathematical modelling of imperfect maintenance of a system under competing risk. The components under consideration are repaired upon failure, but are also preventively maintained. The preventive maintenance (PM) is performed periodically with some fixed period  $\tau$ , but PM can also be performed out of schedule due to casual observation of an evolving failure. The maintenance need not be perfect; the model we propose is motivated by Brown and Proschan's imperfect repair model, but extended to model preventive maintenance as one of several competing risks. We model the unscheduled PM by an instance of Cooke's random signs model. This helps us avoiding problems of identifiability previously reported in connection with Brown and Proschan's imperfect repair model. Parameter estimation in the model is based on Markov Chain Monte Carlo simulation. The data required to estimate the parameters in the model we propose are the intermediate failure times, the "winning" failure mechanism associated with each failure (i.e. the failure mechanism leading to the failure), as well as the maintenance activity. This data is found in most modern reliability data banks.

The model is tested using a real-life data-set from the OREDA database, and the results are compared to those of other standard repair models.