Failure Time Models Based On Degradation Processes

Axel Lehmann

Department of Computer Science, Mathematics and Natural Sciences
HTWK Leipzig University of Applied Sciences
D-04251 Leipzig
Germany
lehmann@imn.htwk-leipzig.de

Abstract

Many failure mechanisms can be traced to underlying degradation processes and stochastically changing covariates. Degradation and covariate data can provide much reliability information additional to failure-time data and are particularly useful when the application of traditional reliability models is limited due to rare failures of highly reliable items or due to items operating in dynamic environments. This talk surveys some approaches to model the relationship between failure time data and degradation and covariate data. These models which reflect the dependency between system state and system reliability include threshold models and hazard-based models. In particular, we consider the class of degradation-threshold-shock-models in which failure is due to the competing causes of degradation and trauma. For this class of reliability models we compute the survival function of the resulting failure time and derive the likelihood function for the joint observation of failure times and degradation data at discrete times. We consider a special class of degradation-threshold-shock-models where degradation is modeled by a process with stationary independent increments and related to external covariates through a random time scale and extend this model class to repairable items by a marked point process approach. The proposed model class provides a rich conceptual framework for the study of degradation-failure issues.