Statistical inference for Wiener degradation models under imperfect maintenance and general observation schemes

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Degradation modelling is essential in reliability engineering and predictive maintenance. In real-world industrial applications, systems frequently undergo imperfect maintenance that only partially restore their health, and degradation measurements are often irregular or incomplete. This work introduces a framework to overcome these practical limitations. We model the underlying continuous degradation using a Wiener process and represent the effect of imperfect maintenance through the Arithmetic Reduction of Degradation (ARD) model. We develop a Maximum Likelihood Estimation (MLE) methodology capable of handling a general observation scheme, including missing data and varying inspection schedules (before, after, or between maintenance actions). This model is extended to bivariate degradation processes, using a shared-noise approach to capture environmental dependencies between multiple components. To support practical decision-making, we provide prediction intervals that capture the uncertainty of both the model and the parameter estimation. The applicability of this methodology is demonstrated through a real-world case study on critical components from the energy sector, showing how this framework can effectively predict future degradation and optimize maintenance scheduling.

Estimating the carrying capacity of endangered species

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In this talk we consider population-size-dependent branching processes (PSDBPs), which are stochastic models that describe the dynamics of populations living in habitats where the resources are limited and whose individuals reproduce independently of the others.

We focus on PSDBPs whose extinction occurs almost surely and, in a parametric framework for the offspring distribution, address the estimation of the parameters of the model. Based on the observation of the population sizes, a new least-square estimator is introduced. The asymptotic properties of this estimator are analysed and its C-consistency and asymptotic normality are established. The results are applied to a real dataset on a threatened bird: the black robin population.

This is a joint work with Peter Braunsteins (UNSW Sydney) and Sophie Hautphenne (University of Melbourne).

Robust estimation of central tendency for fuzzy-valued data

Beatriz Sinova, University of Oviedo

Imprecision is inherent to many real-life situations from fields as diverse as Social Sciences, Medicine or Engineering. A useful way to cope with it is to consider random fuzzy sets, for which an appropriate statistical methodology has been developed for decades. Nevertheless, most of these techniques involve non-robust central tendency measures, which may compromise conclusions when data contain outliers or errors. Inspired by robust statistics, several alternatives for summarizing the central tendency (and others for the scale) of fuzzy-valued data have been introduced in the literature. In particular, trimmed means and location M-estimators have shown a good finite-sample performance under contamination, and their robustness has been proved by means of the finite sample breakdown point. These measures and more recent approaches, such as fuzzy medoids, will be illustrated using a real-life example.