

Degradation Analysis for Non-decreasing Gamma Process with Lower Limit of Detection

Yi-Fu Wang

Department of Statistics, National Cheng Kung University, Tainan, Taiwan

Abstract

For highly reliable products, degradation analysis is a common used tool to obtain the product's lifetime prediction. Moreover, the gamma process (GP) is widely used to deal with the monotonic degradation path. However, in some situation, the degradation data may exist the zero-increment phenomenon, such that the GP is not suitable for analyzing this kind of degradation data. To deal with the non-decreasing degradation data, Lin (2017) proposed the non-decreasing gamma process (NGP) model. However, the probability of zero-increment should be related to tested time. Thus, Wang and Chen (2020) extended the NGP model to construct the non-homogeneously non-decreasing gamma process (NNGP) model to improve the model fitting. But sometimes, the non-linear function may not capture the behavior of zero-increment very well. Motivated by that, we attempt to propose an alternative model, non-decreasing gamma process with lower limit of detection (NGP_LLD) model, to deal with non-decreasing degradation data. Next, we preform the simulation studies to examine the proposed NGP_LLD model. Finally, the results of real data demonstrate that the NGP_LLD model can capture the zero-increment and provides a good lifetime's prediction better than the NNGP model in some cases.

Keywords:

Degradation analysis; Gamma process; Nondecreasing; Zero-increment; Limit of Detection.