A Bayesian risk-based approach to the design of single-sampling plans for attributes

Ajmal Muhammad, Jan Verwaeren, and Stijn Luca

Ghent University,

Department of Data Analysis and Mathematical Modelling,

Ghent, Belgium.

Acceptance sampling plays an imperative role in quality control. It is a common technique employed across various industries to assess the quality of products. The decision to accept or reject a lot depends upon the inspection of a random sample from that lot. However, traditional approaches often overlook valuable prior knowledge on product quality. Moreover, existing Bayesian literature primarily focuses on economic considerations, employing complex cost functions and overlooking the probabilistic risks of rejecting satisfactory lots or accepting unsatisfactory lots that are inherently associated with the sampling process. Until the present, a Bayesian formulation of these risks has not yet been considered in the design of acceptance sampling plans.

This work addresses this gap by proposing a novel approach to designing single-sampling plans for attributes utilizing Bayesian risks. More specifically, it extends the two-point method for designing a sampling plan for attributes to a Bayesian framework enabling the incorporation of prior knowledge on the product quality into the design process. For this purpose, we used Bayesian risks (a so-called modified and Bayes's risks defined earlier by Brush (1986)) to develop search strategies aimed at designing plans that effectively reduce these risks.

Experiments reveal that the design procedure allows the sample size to adapt to the prior knowledge on product quality. When the prior suggests good quality, less stringent sampling plans with lower sample sizes are obtained. When prior indicates bad quality, the behaviour of the resulting sampling plan is highly determined by the type of risks used in the design.