On Phase II nonparametric CUSUM exceedance control charts for unknown location

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Standard control charts are often based on the assumption that the observations follow a specific parametric distribution, such as the normal. In many applications we do not have enough information to make this assumption and in such situations, development and application of control charts that do not depend on a particular distributional assumption is desirable. Nonparametric or distribution-free control charts can serve this wider purpose. A key advantage of nonparametric charts is that the in-control run-length distribution is the same for all continuous process distributions. In this paper we examine several aspects related to the efficient design and implementation of a class of Phase II nonparametric cumulative sum (CUSUM) charts based on the exceedance statistic. Here we investigate which order statistic (percentile), from the reference (Phase I) sample, should be used to obtain the best performance. It is observed that other choices than the median, such as the third quartile, can play an important role in improving the performance of the chart. We also study different choices of the CUSUM design parameter, k, called the reference value. Moreover, although the most widely used chart performance metric is the average run-length (ARL), certain shortcomings have been observed and instead we use more representative measures for the assessment of chart performance. These include other percentiles of the run-length, more specifically, the median run-length (MRL), which provides additional and more meaningful information about the in-control and out-of-control performances of control charts, not given by the ARL. The procedures are illustrated with some data. A summary and some concluding remarks are given.

Key Words: Distribution-free, robustness, median run-length, order statistics