Contribution ID: **88** Type: **not specified**

Distribution-Free Joint Monitoring of Location and Scale for Modern Univariate Processes

Tuesday, 12 September 2023 11:05 (30 minutes)

Autocorrelated sequences of individual observations arise in many modern-day statistical process monitoring (SPM) applications. Often times, interest involves jointly monitoring both process location and scale. To jointly monitor autocorrelated individuals data, it is common to first fit a time series model to the in-control process and subsequently use this model to de-correlate the observations so that a traditional individuals and moving-range (I-MR) chart can be applied. If the time series model is correctly specified such that the resulting residuals are normal and independently distributed, then applying the I-MR chart to the residual process should work well. However, if the residual process deviates from normality and/or, due to time series model misspecification, contains levels of autocorrelation, the false alarm rate of such a strategy can dramatically rise. In this paper we propose a joint monitoring strategy that can be designed so that its in-control average run length is robust to non-normality and time series model misspecification. We compare its performance to that of the I-MR control chart applied to the residuals under different misspecification scenarios. Our conclusions suggest that the proposed joint monitoring strategy is a useful tool for today's modern SPM practitioner, especially when model misspecification is a concern.

Keywords

Autocorrelation, binary sequences, change point detection, process clipping, quality control, statistical process monitoring (SPM)

Classification

Both methodology and application

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Session Classification: INVITED ASQ