Design of EWMA control charts for monitoring the zero-inflated negative binomial distribution using conditional false alarm rate

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Zero-inflated models are commonly used to handle count data that exhibit over-dispersion and a high frequency of zeros. One of these models is the zero-inflated negative binomial (ZINB) model. This study proposes the implementation of dynamic probability control limits (DPCLs) in exponentially weighted moving average (EWMA) control charts for monitoring processes with ZINB-distributed data. The use of DPCLs in designing the control charts has proven to be very useful to overcome the undesirable performance of the control charts due to change in the sample size, risk scores, or covariate values over time. This study considers the case in which the sample size distribution is not known beforehand or may vary over time. The results demonstrate that this method maintains a consistent conditional false alarm rate for the ZINB-EWMA chart, even when the sample size changes over time. Our findings emphasize the chart's capability to dynamically adjust its control limits in response to fluctuations in sample size. The effect of the ZINB distribution's dispersion parameter on monitoring performance is also examined.

Keywords: Dynamic probability control limits, Exponentially weighted moving average (EWMA) chart, Statistical process control, Statistical process monitoring.