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Design of variance control charts with estimated parameters: A head to head comparison between two perspectives

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Abstract

Since parameter estimation degrades chart performance, it is important to design a control chart correctly, that is, taking account of the estimation effects. To this end, two perspectives are available in the literature: the unconditional, which focuses on the unconditional in-control (IC) average run length ((Formula presented.)), and the conditional, which focuses on the IC run-length distribution conditioned on the parameter estimates and the exceedance probability criterion (EPC). Much of the literature on this topic is in the context of monitoring the mean. However, monitoring the variance is important in the larger monitoring context, not only per se, but also because a reliable and stable estimate of the process variance is required in the first place for setting up the control chart for the mean. With this in mind, and given that a recent paper studied the design of the (Formula presented.) chart, here we consider the S^2 chart and examine the effects of each perspective on the design and IC performance. To this end, we first compare the required number of Phase I samples and the control limit adjustments in two cases: the upper one-sided chart and the equal-tailed two-sided chart. Second, we examine the performance of each chart, designed according to one perspective, under the other perspective. Results show major differences in the impact and consequences of the adopted chart design perspective on chart performance. An illustration with a real dataset is provided. Finally, an overall summary and some conclusions are presented. © 2020 American Society for Quality.

Author keywords

[conditional and unconditional control chart performance](#) [control chart design](#) [control limit adjustments](#)
[one-sided and two-sided control limits](#) [parameter estimation](#) [S² and S control charts](#)

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