Practical Significance and the Modified Control Chart with Estimated Parameters

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This presentation addresses the practical limitations of traditional Shewhart X-bar control charts when applied to highly capable processes. While a point outside the control limits typically triggers an out-of-control signal, such a signal may lack practical relevance when the process continues to produce an acceptably low fraction of nonconforming items. The Modified X-bar Control Chart (MCC) was developed for such situations, but under the assumption of a known standard deviation.

In this study, we extend the MCC to the more realistic case where the standard deviation is estimated from Phase I data. We show that this estimation introduces additional variability, inflating both the false alarm rate and the fraction nonconforming. To address these effects, we derive adjustments to both the acceptable region and the control limits, ensuring that the chart meets pre-specified in-control performance criteria.

A practical example highlights the importance of these adjustments, particularly for small sample sizes, and demonstrates the benefits of using our proposed modified chart. The ideas and results presented are part of a manuscript currently under review at Quality Engineering.

Keywords: Modified Control Chart, Practical Significance, Parameter Estimation, Fraction Nonconforming, False Alarm Rate

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