ABSTRACT

Monitoring Process Dispersion. (August 1995)

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In this research the ARL performance of existing control charts for monitoring dispersion was evaluated by means of a Markov chain approximation and by integral equations. We analyzed and compared the performance of Shewhart charts such as R and S charts, CUSUM charts such as the CUSUM of S and the CUSUM of R, and the EWMA chart of the $\ln S^2$. For individual observations the MR chart, the EWMA chart presented by Wortham and Heinrich and the CUSUM chart presented by Hawkins are compared. We introduced the concept of ARL biased performance for dispersion control charts. We have found that traditional Shewhart charts for dispersion are generally ARL biased. EWMA charts for dispersion may also be ARL biased unless specific asymmetric limits are used.

We present in this work new CUSUM charts for monitoring process dispersion. Some new charts result from a normalizing transformation of the subgroup variance. Another chart called the CPP CUSUM results from applying the likelihood ratio test to the change point problem. When no subgrouping is possible we present new alternatives such as the CUSUM of MR chart, and a modification of the CPP CUSUM chart. The comparison shows that the CPP CUSUM chart has the best ARL performance.

Sensitivity analysis was performed to determine the performance of the CPP

CUSUM chart when observations are non-normal or not independent. For non-normal observations we present a CUSUM chart for monitoring the kurtosis of processes following a symmetric class of distributions. We have also found that when the CPP CUSUM chart is carelessly applied to an AR(1) process its performance becomes ARL biased.

Finally, we evaluate by means of simulation the ARL performance of the joint use of control charts for monitoring process location and dispersion. For this practice we found that the best and easiest way is the use of a pair of CUSUM charts. Although a pair of ARL unbiased EWMA charts is comparable.