Multivariate Bounded Process Adjustment Schemes

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Abstract

We investigate multivariate process adjustment policies in the presence of fixed adjustment costs. A fixed adjustment cost leads to a trade-off between adjusting a process continuously and allowing the process to drift until a bound is violated. The problem of determining the best bounded adjustment policy and the optimal bounded adjustment parameter is addressed. Although the univariate bounded adjustment problem has received interest in the past, there has been little focus on the multivariate case in the literature. It has been shown that in the univariate case, the shape of the optimal adjustment policy is a *dead band*. Determining the shape of the optimal *dead region* and the parameter that defines this region in the multivariate case is a difficult problem. A State-Space model is formulated for the multivariate bounded process adjustment problem and a Kalman Filter based controller is used. With the help of simulation, the optimal bounded adjustment parameter is computed for two specific dead subspace shapes of practical applicability. An investigation of the performance of the simulation-optimization approach is included as the dimensionality of the observations increases. Validation of this approach with the only two analytic results available for deadbands (univariate and bivariate) confirms the accuracy of the optimal solutions found. An illustration in a semiconductor manufacturing process is presented and MATLAB code that implements the methods is developed and made available.

KEYWORDS: Multivariate Process Control, Bounded Adjustment, Adjustment Cost, Optimal Adjustment Policy, Drug dosage management.