New Control Charts for Simultaneous Monitoring of Mean Vector and Covariance Matrix of Multivariate Multiple Linear Regression Profiles

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In some applications of manufacturing and non-manufacturing industries, the quality of processes can be characterized by multivariate multiple linear regression profiles (MMLRPs). In this situation, there are some correlated responses (more than one response) which are dependent to some explanatory variables (more than one explanatory variable). Different methods have been proposed in the literature to monitor MMLRPs in Phase II. Most of the existing control charts separately monitor mean vector and covariance matrix. Simultaneous monitoring of mean vector and covariance matrix of MMLRPs allows practitioners to avoid the inflated false alarm rate which is resulted from using two independent control charts, one for monitoring mean vector and the other one for monitoring covariance matrix. In this paper, we extend a single exponentially weighted moving average semicircle (EWMA-SC) and generally weighted moving average semicircle (GWMA-SC) control charts to monitor the mean vector and covariance matrix of MMLRPs in Phase II simultaneously. In the proposed control charts, all the parameters of the profiles are monitored by only one statistic. In other words, the proposed control charts need only one statistic with one control limit to monitor all the parameters of MMLRPs, simultaneously. These new control charts are compared with the existing EWMA-based control charts in the literature in terms of average run length (ARL) criterion. Finally, the applicability of the proposed control charts is shown by using a real case of calibration application in the Body Shop of an automotive industrial group. The results show the acceptable performance of the proposed control charts rather than the existing ones.

Keywords: EWMA-SC chart, GWMA-SC chart, Multivariate multiple linear regression profiles (MMLRPs), Average run length (ARL)

Multivariate Functional Data Analysis for Ship Performance Monitoring

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Ship performance monitoring in terms of CO_2 emissions is a compelling requirement for shipping companies that are urged to face the recent air pollution programs imposed by the International Maritime Organization. In this context, there is in fact a lack of methods that allow multivariate monitoring during voyages in real time.

On the other hand, the massive amounts of multivariate data, continuously acquired on board of ships equipped with modern multi-sensor systems, have great potential for implementing effective decision-making tools that exploit their multivariate and functional nature.

Once solved the issue of selecting an opportune continuous domain parameter, multivariate functional data can be obtained from discrete observations of the variable profiles, and then, used to give instantaneous information on the ship operating conditions over each voyage.

Under this premise, a new analysis framework is presented for monitoring of ship