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Economic-statistical design of simple linear profiles with variable sampling interval

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Control charts are statistical tools to monitor a process or a product. However, some processes cannot be controlled by monitoring a characteristic; instead, they need to be monitored using profiles. Economic-statistical design of profile monitoring means determining the parameters of a profile monitoring scheme such that total costs are minimized while statistical measures maintain proper values. While varying sampling interval usually increases the effectiveness of profile monitoring, economic-statistical design of variable sampling interval (VSI) profile monitoring is investigated in this paper. An extended Lorenzen–Vance function is used for modeling total costs in VSI model where the average time to signal is employed for depicting the statistical measure of the obtained profile monitoring scheme. Two sampling intervals; number of set points and the parameters of control charts that are used in profile monitoring are the variables that are obtained thorough the economic-statistical model. A genetic algorithm is employed to optimize the model and an experimental design approach is used for tuning its parameters. Sensitivity analysis and numerical results indicate satisfactory performance for the proposed model.

Keywords: profile monitoring; variable sampling interval; economic-statistical design; genetic algorithm; average time to signal

1. Introduction and literature review

Shewhart [30] was the first who introduced control charts as statistical tools to improve quality of products. The implementation of control charts in an organization is associated with some costs. Duncan [6] proposed a cost function for implementing a $\bar{X}$ control chart in which these costs are integrated. However, the designed $\bar{X}$ control chart obtained by Duncan's cost model does not necessarily have good statistical performance. As a result, Saniga [27] developed an economic-statistical model in which Duncan's economic model was considered as the objective function and types I and II error probabilities were considered as statistical constraints.

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