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On the design of Shewhart control charts monitoring dispersion in processes with random shifts*

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Abstract

A key issue for the deployment of control charts in a manufacturing process is the selection of their design parameters: an economic objective can drive the choice of these parameters. Usually, the economic design of a control chart is obtained under the assumption that the shift to the out-of-control condition is deterministic. However, this can result in a too restrictive hypothesis which needs to be removed in many process environments. Furthermore, human resource management decisions can often limit the available labour capacity to perform the SPC. In this paper we determine the robust economic performance of two different one-sided Shewhart charts monitoring the sample standard deviation, constrained by limited labour resource: one of the charts monitors the sample standard deviation *S*, the other monitors a statistic based on a logarithmic transformation of the sample standard deviation. A numerical analysis has been carried out to determine: i) how accurate should be the fit of the random shift; ii) if the use of the logarithmic transformation for the sample standard deviation is favoured by particular process operating conditions. Two benchmarks of examples have been investigated to perform the study.

Key words: Quality Control, Manufacturing, Process Dispersion, Manpower Planning, Regression

1 Introduction

Manufacturing processes are characterized by a certain amount of variability which, in some cases, can strongly affect the quality of the outcome. In general, process variability consists of an "inherent" or "natural" variability, which cannot be eliminated and should be considered as a background noise; sometimes a further source of variability due to the occurrence of a special cause is present in the process: this variability sums to the natural variability and can lead to an unacceptable level of process performance. Processes characterized exclusively by the presence of the natural variability are said to operate in the "in-control" condition; when a special cause occurs, the process state is said to be "out-of-control". In this paper, an increase of the process variability is assumed to exclusively influence the process dispersion: an increase in process dispersion corresponds to data with a larger spread, which causes the production of an excessive number of nonconforming items.

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