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New Sampling Methods in Statistical Process Control

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Abstract

The success of a statistical quality control method is directly related to the type of control chart and especially to the sampling method used. The variability of the process is due to random causes (inherent to the process) or to the presence of assignable causes. The former cannot be economically identified and corrected, whereas the latter should be detected and eliminated. The choice of the control chart depends upon the characteristic being controlled. The quantitative characteristics are controlled using variable control charts ($\overline{X}$-charts, R-charts, or s-charts, for example) or special control charts (EWMA or CUSUM charts for continuous random variables, for example).

For a long time the control charts used had fixed parameters (sampling intervals, sample sizes, and control limits). However, since final of the 1980s, new adaptive control charts have been developed for improved performance. In terms of their implementation, these charts can be classified in two broad categories. The first category encompasses control charts with adaptive parameters (sampling intervals, sample size, and control limits, depending on the sample information). The second category encompasses control charts with predetermined parameters (parameters determined before the beginning of the process to be controlled).
Several measures have been developed to assess the statistical quality controls method's performance across time regarding to how quickly they detect assignable causes. The frequency of false alarms and the number of samples and analysed items are two examples. The ARL ("*average run length*") is perhaps the most widely used statistical measure for assessing the performance of a statistical control chart. But if the control methods have constant and equal sampling intervals, then the time interval up to the detection of a change is directly proportional to the ARL. In the case of non-constant sampling intervals, the proportionality above fails and the ARL is not a measure of the efficiency of the control method. The AATS ("*adjusted average time to signal*"), also known in the literature as "*steady-state performance*", is defined as the average interval of time from the instant at which a failure occurs in the system to the instant at which the control chart detects the failure. More recently a new measure for assessing the performance of a statistical control chart was presented based on the sample frequency in control, denominate ANSIC ("*average number sample in control*").

Keywords: Adaptive and predetermined sampling, performance measure, pdf of the *Laplace*, cumulative hazard rate, quality control.

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