An Attribute Inspection Control Chart for Process Mean Monitoring

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Abstract

This paper proposes a new control chart, denoted by $\bar{X}^{\text{att}}$, for evaluating the stability of a process mean. This chart is based on attribute inspection rather than physical measurements (taken with an instrument such as a caliper or precise balance) of the quality characteristics of interest of the sampled items. Based on a gono-go gauge device (which generates five categorizations), the average of a quality characteristic of interest is controlled. In equally spaced times, samples of n items are collected, and the averages are estimated by means of $\bar{X}^{\text{att}}$ based solely on the obtained categorization to decide whether the process is in control. Once the distribution of $\bar{X}^{\text{att}}$ is calculated, the decision problem is defined in terms of a mathematical programming formulation to find the dimensions to be used in the gono-go gauge and to find the control limits that minimize the average run length (ARL) for the out-of-control situation and that are constrained to a prefixed ARL for the under-control situation. As shown by extensive computational experiments, the newly introduced $\bar{X}^{\text{att}}$ control chart outperforms the conventional $\bar{X}$ control chart for small shifts in the means and is still competitive otherwise. Because the new $\bar{X}^{\text{att}}$ control chart uses attributes, it can be considered a viable alternative to the conventional $\bar{X}$ control chart.

Keywords: Quality, control chart, optimization, attribute and variable control charts, average run length.