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Control charts —

Part 9:

Control charts for stationary processes

Cartes de contrôle —

Partie 9: Cartes de contrôle de processus stationnaires



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Foreword

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Introduction

Statistical process control (SPC) techniques are widely used in industry for process monitoring and quality improvement. Various statistical control charts have been developed to monitor the process mean and variability. Traditional SPC methodology is based on a fundamental assumption that process data are statistically independent. Process data, however, are not always statistically independent from each other. In the industry for continuous productions such as the chemical industry, most process data on quality characteristics are self-correlated over time or autocorrelated. In general, autocorrelation can be caused by the measurement system, the dynamics of the process, or both. In many cases, the data can exhibit a drifting behaviour. In biology, random biological variation, for example the random burst in the secretion of some substance that influences the blood pressure, can have a sustained effect so that several consecutive measurements are all influenced by the same random phenomenon. In data collection, when the sampling interval is short, autocorrelation, especially the positive autocorrelation of the data, is a concern. Under such conditions, traditional SPC procedures are not effective and appropriate for monitoring, controlling and improving process quality.

Autocorrelated processes can be classified in two kinds of processes, based on whether they are stationary or nonstationary.

- 1) Stationary process – a direct extension of an independent and identically distributed (i.i.d.) sequence. An autocorrelated process is stationary if it is in a state of “statistical equilibrium”. This implies that the basic behaviour of the process does not change in time. In particular, a stationary process has identical means and variances.
- 2) Nonstationary process.

Detailed information about stochastic process and time series can be found in [Annex A](#).

To accommodate autocorrelated data, some SPC methodologies have been developed. Mainly, there are two approaches. The first approach is to use a process residual chart after fitting a time series model or other mathematical model to the data. Another more direct approach is to modify the existing charts, for example by adjusting the control limits based on process autocorrelation.

The aim of this document is to outline the major process control charts for monitoring both of the process mean and the process variance when the process is autocorrelated.