EWMA Control Charts with estimated parameters -
The effect of data contamination and sampling variability

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Abstract

Statistical process control (SPC) provides tools, such as control charts, to monitor data streams and to signal changes in the data. The topic of this talk is the exponentially weighted moving average (EWMA) control chart. During this talk, I will investigate properties of the EWMA control chart based on estimated parameters. More specifically, I focus on evaluating and understanding the effect of estimation error. The talk consists of two parts, in the first I consider estimating the process parameters (so-called Phase I), next I consider the performance of the EWMA chart when parameters are estimated (the so-called Phase II performance).

Phase I: how to estimate from contaminated data?

In practice, Phase I data often contains unacceptable data. These ‘contaminated’ observations, do not belong to the correctly functioning process and hence need to be identified and eliminated. As they influence the estimates of the in-control process which in turn could affect the monitoring performance in Phase II. I consider various estimation methods that are potentially relevant within the parameter estimation process. The quality of the Phase I study is evaluated in terms of the precision of the resulting estimates as well as the effectiveness of the exploratory data analysis.

Phase II: effect of estimation on performance

As a control chart is based on Phase I estimates, its control limits and hence
performance will be conditional on the Phase I sample obtained. The typical measure of Phase II control chart performance, the average run length (ARL), becomes a random variable due to the selection of a Phase I data set for estimation. To quantify this sampling variability, I use a specific aspects of the ARL distribution: the standard deviation of the average run length (SDARL). The results show that EWMA charts require a much larger amount of Phase I data than previously recommended in the literature in order to sufficiently reduce the variation in the chart performance. Because it could be extremely difficult to lower the variation in the in-control ARL values sufficiently due to practical limitations on the amount of the Phase I data, I discuss an alternative design criterion.

About the Speaker

Inez Maria Zwetsloot (1988) holds a MSc degree in Economics with a specialization in Econometrics (2012) from the mPhil research programme at the Tinbergen Institute, the Netherlands. Inez also obtained a BSc in Econometrics (2010) from the University of Amsterdam. Inez' research focusses on industrial statistics with a focus on statistical process monitoring and process improvement. She wrote her PhD dissertation, entitled ‘EWMA Control Charts in Statistical Process Monitoring’ from 2012 to 2015 at the Operations Management department of the Amsterdam Business School of the University of Amsterdam. Her anticipated defence date is April 22nd, 2016. During the same period, Inez was also statistical consultant at the Institute of Business and Industrial Statistics, a consultancy firms which is part of the Amsterdam Business School. IBIS UvA is a centre of expertise in Lean Six Sigma and industrial statistics. It supports quality and efficiency improvement initiatives in Dutch and international organizations. In this role, Inez trained project leaders (Lean Six Sigma Green and Black Belts) from various organization in the Netherlands. Also, she was supervisor of (Lean Six Sigma) improvement projects. At the Amsterdam Business School, Inez taught various courses in applied statistics and process improvement. She was lecturer and coordinator for the course Quantitative Methods for the regular MBA at the Amsterdam Business School. In addition to her interest in the application of statistics, Inez is an active player of field hockey and badminton. Furthermore, she has a taste for traveling across the world.

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