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Classes of Multivariate Semiparametric Control Charts with Applications to Big Data

The focus on every experimental process is observing, studying and understanding phenomena, which are of multivariate nature. The rapid growth of computational power, in combination with the existence of different statistical packages, has facilitated the data collection and led to the development of statistical techniques for monitoring and surveillance. In real world settings, the characteristics under study are correlated with each other and are often comprised of both interval/ratio scale measurements and categorical (ordinal/nominal) variables, especially when the data sets are collected from clinical experience.

In the present work, we first introduce a class of multivariate semiparametric control charts for the simultaneous monitoring location, scale or both, which exploits the theory of order statistics, concomitants and copulas. Key features of the new schemes include: the identification of the characteristic(s) under study which triggered an alarm, and whether the alarm was triggered because of a mean or a variance shift, extension to higher dimensions, and almost purely nonparametric behavior.

Furthermore, we introduce a novel, machine learning, and artificial intelligence monitoring procedure for the joint surveillance of quantitative and qualitative variables, which leverages the idea of clustering to the traditional statistical process control. The advantages of these charts are their ability to harness high dimensional, mixed-type data, their semiparametric nature, the fast convergence and robustness of the algorithmic procedure.

Finally, the evaluation of the performance of all the proposed control charts is discussed, and their implementation is demonstrated using real-world data sets, mainly from the area of biostatistics.

Special/ Invited session

Classification

Both methodology and application

Keywords

statistical process control, artificial intelligence algorithm, big data

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