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## Multivariate Six Sigma: A Case Study in a Chemical Industry

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The large volume of complex data being continuously generated in Industry 4.0 environments, usually coupled with significant restrictions on experimentation in production, tends to hamper the application of the classical Six Sigma methodology for continuous improvement, for which most statistical tools are based in least squares techniques. Multivariate Six Sigma [1], on the other hand, incorporates latent variables-based techniques such as principal component analysis or partial least squares, overcoming such limitation.

However, trying to optimize very tightly controlled processes, for which very small variability is allowed for the critical to quality characteristic of interest, may still pose a challenge in this case. This is because, in absence of first-principles models, data-based empirical models are required for optimization, but such models will perform poorly when the response variable barely varies. This is typically the case in a lot of chemical processes where the selectivity of a reaction has remained mostly constant in the past, but then an improvement is required on it: since historical data shows not enough excitement in this parameter, no model can be built to optimize it.

This work presents the challenges in applying the Multivariate Six Sigma methodology to a chemical reaction in a real industrial case study in order to optimize its selectivity, for which a proper predictive model could not be directly obtained.

[1] A. Ferrer, "Multivariate six sigma: A key improvement strategy in industry 4.0," *Quality Engineering*, 33(4):758–763, 2021.

### Keywords

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### Classification

Mainly application

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