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Nonparametric tests for multivariate stability data

Stability studies are commonly conducted to evaluate how product characteristics evolve during storage. In many industrial applications, several quality attributes are measured repeatedly over time for multiple products, generating multivariate longitudinal datasets. A key objective in these studies is to compare products in terms of their stability and identify those exhibiting more stable behavior during storage.
This work investigates nonparametric permutation-based approaches for the analysis of multivariate stability data collected at different time points. To properly account for the longitudinal structure of the data, a restricted permutation strategy is adopted. This approach preserves the temporal dependence of the measurements while allowing valid inference on differences between products.
Partial permutation tests are performed for each quality attribute, and the resulting p-values are combined using the Nonparametric Combination (NPC) methodology to obtain a global assessment of product differences across the multivariate responses. The proposed framework enables the construction of a ranking of products according to their stability while avoiding distributional assumptions and remaining suitable for small sample sizes or heterogeneous variables.
The methodology provides a flexible and robust tool for the analysis of multivariate stability studies and supports product comparison and decision-making in industrial applications.

Special/ Invited session

Classification

Both methodology and application

Keywords

Stability, Nonparametric statistics, Permutation tests

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