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### Functional confidence bands for lichen biodiversity profiles: A case study in Tuscany region (central Italy)

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## Abstract

Biomonitoring techniques are widely used to assess environmental damages through the changes occurring in the composition of species communities. Among the living organisms used as bioindicators, epiphytic lichens, are recognized as reliable indicators of air pollution. However, lichen biodiversity studies are generally based on the analysis of a scalar measure that omits the species composition. For this reason, we propose to analyze lichen data through diversity profiles and the functional data analysis approach. Indeed, diversity profiles may be naturally considered as functional data because they are expressed as functions of the species abundance vector in a fixed domain. The peculiarity of these data is that the functional space is constituted by a set of curves belonging to the same family. In this context, simultaneous confidence bands are obtained for the mean diversity profile through the Karhunen-Love (KL) decomposition. The novelty of our method lies in exploiting the known form of the function underlying the data. This allows us to work directly on the functional space by avoiding smoothing techniques. The confidence band procedure is applied to a real data set concerning lichen data in Tuscany region (central Italy). Confidence bands functional data analysis intrinsic diversity profile lichen data mean function KL expansion.

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