Interpreting the principal component analysis of multivariate density functions

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Résumé en anglais	Functional principal component analysis (FPCA) as a reduction data technique of a finite number T of functions can be used to identify the dominant modes of variation of numeric three-way data. We carry out the FPCA on multidimensional probability density functions, relate this method to other standard methods and define its centered or standardized versions. Grounded on the relationship between FPCA of densities, FPCA of their corresponding characteristic functions, PCA of the MacLaurin expansions of these characteristic functions and dual STATIS method applied to their variance matrices, we propose a method for interpreting the results of the FPCA of densities. This method is based on the investigations of the relationships between the scores of the FPCA and the moments associated to the densities. The method is illustrated using known Gaussian densities. In practice, FPCA of densities deals with observations of multidimensional variables on T occasions. These observations can be used to estimate the T associated densities (i) by estimating the parameters of these densities, assuming that they are Gaussian, or (ii) by using the Gaussian kernel method and choosing the matrix bandwidth by the normal reference rule. Thereafter, FPCA estimate is derived from these estimates and the interpretation method is carried out to explore the dominant modes of variation of the types of three-way data encountered in sensory analysis and archaeology.
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