

A sandwich smoother for spatio-temporal arrays and time series

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Statistical analysis of spatio-temporal data has evolved over time to handle increasingly large data sets. E.g., the North American CORDEX program is producing daily values of climate-related variables on spatial grids with approximately 80,000 locations over 150 years. In order to perform a functional data analysis of this type of data, one must represent the discretely observed process as a function. Traditional tensor-based methods for representing functional data can quickly break down under the size of such massive data, while principal components-based approaches risk throwing away useful information. We propose a penalized spline method for representing continuous, smoothly varying spatio-temporal functional data using a generalization of the sandwich smoother proposed Xiao et al. (2013). Unlike the original method, the generalization treats the spatial and temporal dimensions distinctly and allows the methodology to be applied to non-gridded data. We demonstrate the practicality of the methodology using both simulated and real data.