

Inference for spatial regression models with functional response using a permutational approach

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Abstract

The aim of this contribution is to introduce an approach to hypotheses testing in a functional linear model for spatial data. The inferential procedure will firstly be demonstrated on a functional-on-functional case of homoscedastic data recorded in time and space, with a real world application to the transportation research. This case study is focused on modelling the driving speed on an expressway interchange in Brno, Czech Republic. Then, the potential of permutation testing will be demonstrated under the presence of spatial correlation among functional observations, with all necessary considerations in methodology. The proposed method can deal with the spatial structure of data by building a permutation testing procedure on spatially filtered residuals of a spatial regression model. Indeed, due to the spatial dependence existing among the data, the residuals of the regression model are not exchangeable, breaking the basic assumptions of the Freedman and Lane permutation scheme. Instead, it is proposed here to base the permutation test on approximately exchangeable spatially filtered residuals, i.e. the variance-covariance structure of the residuals is estimated by variography and then the correlation of the residuals is removed by a spatial filtering. A simulation study is conducted, intended to evaluate the performance of the proposed method in terms of empirical size and power under different covariance settings. It will be shown that neglecting the residuals spatial structure in the permutation scheme, i.e., permuting the correlated residuals directly, yields a very liberal testing procedures, whereas the proposed procedure based on spatially filtered residuals is close to the nominal size of the test. The methodology is demonstrated on a real world data set on the yearly production of municipal waste in the Venice province in Italy, collected between years 1997 and 2011.

Keywords

Functional geostatistics, Functional-on-functional regression model, Permutation tests, Spatial correlation, Spatial functional regression model.

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References

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