

Cross-sectional and Longitudinal Penalized Functional Regression

Jeff Goldsmith

Abstract

We develop fast-fitting methods for generalized functional linear models. The functional predictor is projected onto a large number of smooth eigenvectors and the coefficient function is estimated using penalized spline regression. Our method can be applied to many functional data designs, including functions measured with and without error, sparsely or densely sampled over regular or irregular grids. The methods also extend to the recent but increasingly relevant longitudinal case, in which functional predictors and scalar outcomes are recorded over multiple visits. The approach can be implemented using standard mixed effects software or in a Bayesian framework. We are motivated by a study of white matter demyelination via diffusion tensor imaging in which various cerebral white matter tract properties are used to predict cognitive and motor decline in multiple sclerosis patients. All methods are implemented in the ‘refund’ package available on CRAN.