Hypothesis Testing in Large-scale Functional Linear Regression

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Abstract: We explore the functional linear regression by focusing on the large-scale scenario that the scalar response is associated with potentially an ultra-large number of functional predictors, leading to a more challenging model framework than the classical case. The emphasis is to establish rigorous procedures for testing general hypothesis on an arbitrary subset of regression coefficient functions. Specifically, we exploit the techniques developed for post-regularization inference, and propose a new test for the large-scale functional linear regression based on a decorrelated score function that separates the primary and nuisance parameters in functional spaces. Likewise, we also devise the corresponding decorrelated Wald and likelihood ratio tests and establish the exact equivalence among these three tests for the model under consideration. The proposed test is shown uniformly convergent to the prescribed significance, and its finite sample performance is illustrated via simulation studies and a dataset arising from the Human Connectome Project for identifying brain regions associated with emotional tasks.