

**NONPARAMETRIC BOOTSTRAP INFERENCE IN A SPATIAL-TEMPORAL  
MODEL**

by

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## ABSTRACT

Nonparametric procedures based on the bootstrap are proposed for testing two assumptions in the course of estimating a spatial-temporal model: constant temporal effect across locations/spatial units and constant spatial effect across time. Bootstrap methods for time series and in regression analysis are used to approximate the sampling distribution of the temporal and spatial parameters, respectively. Bootstrap confidence intervals on the temporal and spatial parameters are constructed for the test procedures and a p-value appropriate for the bootstrap called type-2 p-value is also used parallel to the bootstrap confidence interval. Given the spatial-temporal model, the bootstrap estimators of the temporal and spatial parameters are shown to be consistent.

Simulation studies indicate that the proposed procedures can correctly identify the setting of parameters, whether it is indeed constant or not constant over spatial units (or time points) for sufficiently large data. The power of the test increases to one as the alternative parameter values become distant from the common value. Presence of spatial clustering can improve the sensitivity of the test for constant spatial effect across time.

Bootstrap inference is facilitated when the bootstrap statistic is normal. The normality of the bootstrap statistic depends on the magnitude of the parameter value and the properties of the basic estimator. A sample size of at least 50 for time series is sufficient to yield correct inference when testing for constant temporal effect across spatial units and the power of the test tends to be higher for larger sample sizes. The testing procedure for constant temporal

effect across spatial units is not robust to misspecification of the temporal model since the bootstrap for time series requires the estimation of an adequate model. On the other hand, the testing procedure for constant spatial effect across time is robust to model misspecification.