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INFERENCE FOR STRUCTURAL BREAKS IN SPATIAL MODELS

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Abstract: Testing for structural changes in spatial trends constitutes an important issue in many biomedical and geophysical applications. In this paper, a novel statistic based on a discrepancy measure over small blocks is proposed. This measure can be used not only to construct tests for structural breaks, but also to identify the change-boundaries of the breaks. The asymptotic properties and limit distributions of the proposed tests are also established. To derive the asymptotics, the notion of spatial physical dependence is adopted to account for the spatial dependence structure. A bootstrap procedure is applied to the proposed statistic to handle the asymptotic variance of the limit distribution. The method is illustrated by means of simulations and a data analysis.

Key words and phrases: Change-boundaries, discrepancy measure, inference, non-stationary processes, spatial trends.

1. Introduction

Inference for second-order stationary spatial statistical models with a constant mean and a stationary covariance structure has been a topic of active study; see, for example, the seminal text of Cressie (1993) for a comprehensive introduction. When data are affected by topographical structures, sudden events, abrupt policy changes, and other local issues, the second-order stationarity assumption becomes questionable. A misspecified model can often result in inefficient inference and inaccurate predictions. Thus, it is important to test for stationarity, and when nonstationarity is detected, to identify a change boundary. The main objectives of this study are to deal with these two tasks in a structural break context. Specifically, consider the two-dimensional spatial trend model:

$$Y_{\boldsymbol{i}} = \mu\left(\frac{\boldsymbol{i}}{\boldsymbol{n}}\right) + \varepsilon_{\boldsymbol{i}}, \quad \boldsymbol{i} = (i_1, i_2) \in [\mathbf{1}, \boldsymbol{n}] \cap \mathbb{Z}^2, \tag{1.1}$$

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