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Spatiotemporal Kriging with External Drift

Mohsen Mohammadzadeh* and Maryam Sharafi

Tarbiat Modares University

Extended Abstract. In statistics it is often assumed that sample observations are independent. But sometimes in practice, observations are somehow dependent on each other. Spatiotemporal data are dependent data which their correlation is due to their spatiotemporal locations. Spatiotemporal models arise whenever data are collected across both time and space. Therefore such models have to be analyzed in terms of their spatial and temporal structure. Usually a spatiotemporal random field $\{Z(s,t) : (s,t) \in D \times T\}$ is used for modeling the spatiotemporal data, where $D \subset R^d, d \geqslant 1$ is a space region and $T \subseteq R$ is a time region. One of the fundamental subjects in analyzing such data is prediction. In spatial statistics, assuming that the spatiotemporal random field $Z(s,t)$ is stationary with finite variance at all coordinates $(s,t) \in D \times T$, and spatiotemporal covariance function $C(h,u) = \text{cov}(Z(s,t), Z(s+h,t+u))$ exists, the unknown value of the random field at a given location (s_0,t_0) is usually predicted with kriging as the best linear unbiased predictor. In practice, the spatiotemporal covariance function is unknown and a positive definite function should be fitted to the estimates of the covariance function. To ensure that a valid spatiotemporal covariance model is fitted to the data, one usually considers a parametric family whose members are known to be separable positive definite functions. A separable spatiotemporal covariance function might decompose into sum or product of a purely spatial and a purely temporal covariance function. In this paper the product-sum model introduced by De Iaco et al. (2001) is used to determine the spatiotemporal correlation of the data.

In some applied problems, in addition to the values of an attribute of interest $Z(\cdot,\cdot)$, some additional information is available in each sample location, so the precision of prediction would be improved by their implementation. In this paper, to exploit this additional information in kriging, two techniques

* Corresponding author

for spatiotemporal kriging of temperature are compared. The first technique, spatiotemporal ordinary kriging, is the simplest of the two, and uses only information about temperature. The second technique, spatiotemporal kriging with external drift, uses also the relationship between temperature and height to aid the interpolation. It is shown that the behavior of the temperature predictions is physically more realistic when using spatiotemporal kriging with external drift. The implementation of spatiotemporal kriging with external drift, then, is illustrated in a real problem, consisting of maximum and minimum temperature of 6 provinces in Iran.

Keyword. spatiotemporal data; universal kriging; kriging with external drift.

Reference

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Mohsen Mohammadzadeh
Department of Statistics,
Faculty of Pure Sciences,
Tarbiat Modares University,
Tehran, Iran.
e-mail: *mohsen_m@modares.ac.ir*

Maryam Sharafi
Department of Statistics,
Faculty of Pure Sciences,
Tarbiat Modares University,
Tehran, Iran.
e-mail: *r_mmaryamsharafi@gmail.com*

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