Towards reliable spatial prediction

Estimation of the variogram and associated parameters in spatial analysis is

important for assessing spatial dependence and in predicting values of the

measured variable at unsampled locations i.e. kriging. A simulation study is implemented to compare the performance of (i) Gaussian restricted maximum likelihood (REML) estimation, (ii) curve-fitting by ordinary least squares and (iii) nonparametric Shapiro-Botha estimation for estimating the covariance structure of a stationary Gaussian spatial process and a spatial process with t-distributed margins. Processes with Matern covariance functions are considered and the parameters estimated are the nugget, partial sill and practical range. Both parametric and nonparametric bootstrap distributions of the estimators are computed and compared to the true marginal distributions

of the estimators. Gaussian REML is the estimator of choice for both Gaussian and t-distributed data

and all choices of Matern variogram. However, accurate estimation of the Matern shape

parameter is critical to achieving a good fit while this does not affect the Shapiro-Botha

estimator. The parametric and nonparametric bootstrap both performed well, the latter being better for the Shapiro-Botha estimates. A numerical example, obtained from environmental monitoring, is included to illustrate the application of the methods and the bootstrap.