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A new statistic to express the uncertainty of kriging predictions for purposes of survey planning.

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It is well-known that one advantage of kriging for spatial prediction is that, given the random effects model, the prediction error variance can be computed a priori for alternative sampling designs. This allows one to compare sampling schemes, in particular sampling at different densities, and so to decide on one which meets requirements in terms of the uncertainty of the resulting predictions.

However, the planning of sampling schemes must account not only for statistical considerations, but also logistics and cost. This requires effective communication between statisticians, soil scientists and data users/sponsors such as managers, regulators or civil servants. In our experience the latter parties are not necessarily able to interpret the prediction error variance as a measure of uncertainty for decision making.

In some contexts (particularly the solution of very specific problems at large cartographic scales, e.g. site remediation and precision farming) it is possible to translate uncertainty of predictions into a loss function directly comparable with the cost incurred in increasing precision. Often, however, sampling must be planned for more generic purposes (e.g. baseline or exploratory geochemical surveys). In this latter context the prediction error variance may be of limited value to a non-statistician who has to make a decision on sample intensity and associated cost.

We propose an alternative criterion for these circumstances to aid communication between statisticians and data users about the uncertainty of geostatistical surveys based on different sampling intensities. The criterion is the consistency of estimates made from two non-coincident instantiations of a proposed sample design. We consider square sample grids, one instantiation is offset from the second by half the grid spacing along the rows and along the columns. If a sample grid is coarse relative to the important scales of variation in the target property then the consistency of predictions from two instantiations is expected to be small, and can be increased by reducing the grid spacing. The measure of consistency is the correlation between estimates from the two instantiations of the sample grid, averaged over a grid cell. We call this the offset correlation, it can be calculated from the variogram. We propose that this measure is easier to grasp intuitively than the prediction error variance, and has the advantage of having an upper bound (1.0) which will aid its interpretation. This quality measure is illustrated for some hypothetical examples, considering both ordinary kriging and factorial kriging of the variable of interest. It is also illustrated using data on metal concentrations in the soil of north-east England.