Comparison Between Different Kriging Estimators

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Six different geostatistical estimators (linear kriging, lognormal kriging, and disjunctive kriging, each with and without a nonbias, i.e., universality condition) were compared using data from a polymetallic deposit in Algeria. The differences between estimators with and without the nonbias condition were far more pronounced than between the different kriging methods. This highlights the importance of choosing an appropriate stationarity model for the data. The criterion concerning kriging weight of the mean in simple kriging, proposed by Remacre (1984, 1987) and Rivoirard (1984) was found to be helpful for determining blocks where the choice of the stationarity hypothesis was critical.

KEY WORDS: kriging estimators, linear kriging, lognormal kriging, disjunctive kriging.

INTRODUCTION

The Oued-el-Kebir deposit in Algeria is a polymetallic sulfide orebody that currently is being studied to evaluate its economic potential. At the present time, ore grades in Pb, Zn, Cu, and Ag are available for 122 holes (Fig. 1) drilled from the surface, and from underground workings. A detailed description of the geology, the sampling procedure, etc., can be found in Boufassa (1986). Given the shape of the orebody, a two-dimensional study was selected. Because density of the ore varies from 2.5 through to 5.0, the variable studied was the densiometric accumulation:

metal grade × thickness × density

Histograms of the accumulations are skew, and are almost three-parameter lognormal. So three types of kriging were considered: linear kriging, lognormal kriging, and disjunctive kriging. For each of these methods, the kriging system can be written with or without a nonbias condition depending on whether the variable is assumed to be stationary throughout the deposit and the mean is

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assumed known, or whether it is merely locally stationary with an unknown mean.

In a similar study on gold grades with a three-parameter lognormal distribution, Rendu (1979a) showed that the regression of kriged grades versus actual production was in close agreement with theory for four types of kriging: linear kriging and lognormal kriging, each with and without a nonbias condition. This close agreement between theory and results shows that the geostatistical models work well when the data really do have a lognormal distribution, as is the case in South Africa.

Unfortunately, in many other cases such as this one, the data distribution is skew, but not really lognormal. Typically the log-probability plot is linear in the middle of the distribution, but not in the tails (Fig. 2). So the lognormal distribution, though far from perfect, is still a better fit than the normal. Consequently, lognormal kriging can be expected to perform better than linear kriging, but not as well as disjunctive kriging, which can adapt itself to the data distribution. It is interesting to test this in practice.

The next point is to decide how to make comparisons between various types of kriging. Ideally the various kriged estimates should be compared with the corresponding production figures. As these are rarely available block by block, even for producing mines, usually the average of a large number of sample values lying within the block is taken as being representative. This is what Rendu did. In this case, however, the deposit is still at the feasibility stage, so this was not possible. One simple way of comparing various estimates is by plotting them as scatter diagrams. Despite the lack of an absolute reference, the comparisons prove to be instructive and rather unexpected.