Abstract

In the estimation of recoverable reserves of an ore deposit, non-linear kriging techniques are used to calculate the panel-wise ore and metal tonnage by estimating the conditional probability of block grades. In real life mining scenario, it is necessary to consider a change of support model along with non-linear kriging to estimate functions of the variables with larger support than that of the samples. However, under the assumption of strict stationarity, the grade distributions and important recovery functions are estimated by non-linear techniques using the data within a supposedly spatial homogeneous domain. Underlying random function model is required to be stationary in order to carry out the inference on ore grade distribution and relevant statistics. But, in reality, stationary model often falls short in evaluating complex geological structure. It is obvious that the standard stationary models neglect the apparent changes in the local mean and variances and hence produce unreliable results. Moreover, important geological feature such as spatial continuity of the deposit does not get replicated by the conventional stationary model. A better approach to non-linear techniques is required which can handle complicated non-stationarity issues. As a possible alternative in the reserve estimation scenario, local multivariate distributions are assumed to be strictly stationary in the neighbourhood of the panels. The local cumulative distribution function and related statistics with respect to the panels are evaluated by weighting the samples with appropriate distance kernel function. The developed non-stationary non-linear model exploits these local statistics containing local information in the estimation process. Though the practice is computationally more complex than the standard stationary model, the developed model outperforms the conventional one in terms of reserve estimation. This study deals with the theoretical design of the non-stationary model for two important non-linear kriging techniques, disjunctive kriging and multigaussian kriging, allowing change of support model and their application in the mineral reserve estimation scenario. A thorough investigation through simulation experiments is carried out to critically judge the performance of the developed model. The performance of the developed

models is also investigated on a real life dataset from an Indian copper mine as a case study.

Keywords: Reserve estimation; Disjunctive kriging; Multigaussian kriging; Hermite polynomial; Non-stationary; Kernel.