PRECISION OF ESTIMATION OF RECOVERABLE RESERVES: THE NOTION OF CONDITIONAL ESTIMATION VARIANCE

Roland Froidevaux
David S. Robertson & Associates
Toronto, Canada.

ABSTRACT

An empirical approach to the problem of approximating the conditional estimation variance of an ore grade estimate is presented.

Through repetitive sampling of simulated deposits, (representing various types of regionalization), the effects of increasing the cut-off grade, and/or changing the size of the selective mining units on the precision of the ore grade, are analyzed and an approximation formula for the conditional estimation variance is proposed. The performance of this approximation is shown and its theoretical implications, as well as its limitations, are discussed.

INTRODUCTION

One of the tasks carried out routinely by geostatistics is the evaluation of total (or global) mining reserves. This evaluation generally entails two steps:

i) Inferring the distribution of the average grade of the selective mining units (SMU).

ii) Determining the recovered ore grade and tonnage by applying a cut-off grade to this distribution.

Along with the recovered grade and tonnage figures, the geostatistician generally provides an assessment of the

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'global estimation variance', which represents the precision of the overall average grade estimate. This 'global estimation variance' is of limited interest for evaluating the merits of a mining project; it can even be misleading to a reader unaware of geostatistical theory, since said reader is likely to consider it to be the precision of recovered reserves. What is required is the reliability of the estimate of recoverable reserves, given a certain degree of mining selectivity and an envisioned cut-off grade.

The problem of assessing, correctly, the precision of mineable reserves is a critical one when ore reserves have to be classified (FROIDEVAUX, 1982). Indeed, most securities exchange legislations now require that the accuracy limits of an estimate be stated when reporting resources and reserves.

The need for techniques allowing to approximate the conditional estimation variance, therefore, is obvious.

However, despite its importance, the problem of assessing the reliability of total recoverable reserves has been neglected, largely, in the past, and only recently has the subject started receiving its deserved attention (DAGBERT & MYERS, 1982; HARRISON, 1983).

This paper presents an empirical approach to the problem of approximating the ore grade estimation variance: through repetitive sampling of simulated deposits (representing various types of regionalization) the effects of changes in cut-off grade and selective mining unit size on the ore grade precision are analyzed and approximation formula relating the conditional estimation variance to known geostatistical parameters is developed.

POSITION OF THE PROBLEM

Let us consider a deposit D which is recognized by N samples, uniformly distributed over it, at an average spacing of L. Let us assume further that this deposit will be completely mined-out by blocks of size V, and that each of these blocks will be classified either as ore, if its average grade is greater than $z_c$, or otherwise as waste.

The problem at hand, when dealing with total mineable reserve evaluation, is to estimate the recovered ore grade (i.e., the average grade of ore blocks) corresponding to various cut-off grades $z_c$ and to assess the precision of these estimates.