AN OVERVIEW OF GEOSTATISTICAL SIMULATION FOR QUANTIFYING RISK IN THE MINING INDUSTRY

John E. Vann[1], Olivier Bertoli and Scott Jackson
Quantitative Geoscience Pty. Ltd., PO Box 1304 Fremantle, Western Australia, 6959, Australia

This paper presents an overview of geostatistical simulation with in particular focus on aspects of importance to its application for quantification of risk in the mining industry.

Geostatistical simulation is a spatial extension of the concept of Monte Carlo simulation. In addition to reproducing the data histogram, geostatistical simulations also honour the spatial variability of data, usually characterised by a variogram model. If the simulations also honour the data themselves, they are said to be 'conditional simulations'.

Conditional simulations can be regarded as 'equally likely' (equiprobable) images of the mineralisation at a fine scale. In a sense, simulations are an attempt at 'sampling the unknown' using constraints, e.g. statistical moments imposed by the data. Thus, in simulation, the requirements of stationarity are stricter than for linear geostatistics (for example, kriging).

There now exists a plethora of methods and variations of these methods to generate simulations. A short review of the main methods in use in the mining industry today is presented: Turning Bands Simulation; Sequential Gaussian Simulation; Sequential Indicator Simulation and P-field Simulation. We also briefly introduce the concepts of multivariate simulation ('co-simulation').

Geostatistical simulation is much more computationally demanding than geostatistical estimation. However, the exponential increases in computer processing speed, memory and data storage capacity have brought these tools into wide operational use in the mining industry over the past decade. We can generate many (in theory an infinite number) of simulated images. The question still remains: 'how many simulated images are required to properly characterise a given domain?' To answer this we must test the simulations to ensure they reasonably reproduce the input statistics. The validity of any subsequent use of the simulations for risk characterisation will be heavily dependent on how well our set of simulations reproduces the intended 'probability space'.

A brief discussion of the types of applications possible is given and in conclusion we summarise some of the possible pitfalls encountered when generating and using geostatistical simulations for application to risk quantification problems in the mining industry.