A COMPARISON OF ESTIMATION METHODS FOR EVALUATING IRON ORE BODIES

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DECLARATION

I, Elelwani Machaka student number **385412** hereby declares this research report to be my own unaided work. It is being submitted in partial fulfilment for the degree of Master of Science in Engineering at the University of the Witwatersrand. It has not been submitted before for any degree or examination in any other University.

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On this _____ day of_____ (year)_____

ABSTRACT

The estimation of iron (Fe) ore deposits presents a challenge in the mining industry, given the inter-relationship that may exist between the different variables and to preserve the relationship thereof.

Samples are collected at many locations and for each of them analyses for several chemical components are made. For multivariate data it is observed that apart from the spatial correlations(namely using variograms and cross-variograms) amongst the variables, there is also a more or less strong relationship that may exist between the variables(statistical relationships that are expressed as scatterplots and correlations). Any estimation method utilised must be able to preserve the relationship that might exist between variables. The aim of this research was to compare two different estimation methods that could be used in iron ore deposits, with both primary and secondary variables sampled at the same locations. To compare the different estimation methods, a block model was created and four grade variables (%Fe, %SiO_2, %Al_2O_3 and RD) were kriged into each block model, using two different estimation methods namely:

- *Ordinary Kriging(OK),*
- *Ordinary Co-Kriging(OCK).*

The dataset used in this project comprises 21 drillholes which in turn have a total of 292 samples from block 9 of Kapstevel North, found at Kolomela Mine in the Northern Cape. This dataset is isotopic, given that 98% of the variables of interest, %Fe, %SiO_2, %Al_2O_3 and RD, are present in all locations for most of the samples, if not all.

Point Simulation at a very fine mesh was run and re-blocked to *Block Simulation. Point Simulation* was compared to the raw data to check for representativity and to satisfy the *Conditional Simulation* properties. *Conditional Simulation* properties are as follows:

- Simulated grades must honour the raw data
- Simulated grades must honour the histogram of the raw data
- Simulated grades must honour the variograms of the raw data

Point Simulation was re-blocked to *Block Simulation* for comparison with the blocked kriged estimates. *Twenty Conditional Simulations* were run in order to formulate ground truth to

compare the kriged estimates with, but only five which adequately represented the input dataset was used in the study.

The results thereof were compared and summarised thus looking at Pearson correlation coefficient between the kriged estimates and the ground truth, kriging variance, slope of regression for all two estimation methods.

Results from the study have shown that OK and OCK perform equally when the primary and secondary variables are sampled at the same locations(isotopic) and have strong correlation; however the study has demonstrated the benefit of using Ordinary Co-kriging when dataset is partially heterotopic(opposite of isotopic).