Optimal Ore Blending Given Geological Uncertainty

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ABSTRACT

A material aim when feeding ore blends into a processing facility is to reduce the variability of the properties of the feed material. Our paper on optimal blending of coking coal given geological variability in 2019 introduced integer-programming techniques to both maximise value and minimise feed or product variability. We discussed an application where the geological uncertainty was characterised by a normal distribution, and exact solutions were readily obtainable using second order conic constraints in the mathematical model.

Geological uncertainty is not always normally distributed, many properties will be characterised by log normal or some other skewed distribution. For example, copper is usually some form of lognormal, and Fe in Iron ore has a left skewed distribution. In this paper, we discuss some distribution free techniques to smooth the variability of plant feed or output given some quantified geological uncertainty. We discuss the sample average approximation method as well as the heuristic method of lazy constraints, to reduce solution times to be practically applicable.

Evaluating a case study demonstrates that the explicit use of non-normally distributed geological uncertainty can smooth the properties of processing feed and potentially add significant value. This approach is equally applicable to all mining and processing operations that blends material into a processing facility or directly into a saleable product.