## ABSTRACT

This thesis provides a detailed study of the semi-variogram. Included is a thorough presentation of the theory of semi-variograms, ranging from the probabilistic model of geostatistics to validity, estimation and modelling of the semi-variogram. A detailed study of the nugget effect parameter is included in which the composition of the nugget effect and the concept of measurement error being part of the nugget effect are explored. The influence that support size has on the semi-variogram parameters is also presented. Practical guidelines into modelling the best semi-variogram are given, and the problems associated with modelling semi-variograms over limited and clustered or widely spaced data is investigated in detail.

This thesis looks at semi-variograms from a South African deep-level gold mining standpoint, and its ultimate goal is to provide a thorough investigation of the semi-variogram from both a theoretical and a practical perspective. Much of the theory presented is tested against real-life gold mining data sets, and the theoretical as well as practical implications of semi-variogram estimation and modelling are discussed. A particularly interesting observation is the potential under-estimation of the sill, nugget and range parameters of the semi-variogram when faced with limited, clustered gold mining data.

However, most of the theory presented in this thesis can be generalized to situations outside of the gold mining industry, and it is believed that many of the practical results observed can also be used outside of gold mining. Therefore, although targeted primarily at the gold mining professional, this thesis is equally valid to interested persons involved in other spatial disciplines.