Preface

This Brief takes readers, in particular environmental scientists, through the important steps of a geostatistical analysis. Most properties of the environment, such as rainfall, plant nutrients in the soil and pollutants in the air, are measured effectively at points between which there are large gaps. The environment is continuous, however, and environmental scientists and their clients typically want to know the values of those properties between the points, in the gaps; they want to predict in a spatial sense from their data, taking into account the locations of their observations. Geostatistics comprises a set of tools that enable them to do that optimally by methods established for properties that appear to vary randomly in one, two or three dimensions. The variogram is the central tool of geostatistics. It enables scientists to assess whether their data are spatially correlated and to what extent. With a suitable model for it they can combine it with their data to predict by kriging, which in its simpler forms is one of weighted averaging. Kriging is an optimal method of prediction in that it provides unbiased estimates with minimum variance. The technique is now available in many statistical packages so that users can apply it at the press of a few buttons without any idea of what their experimental variogram is like or whether an appropriate model has been fitted to it. We warn against the practice.

We take readers through the stages of computing a reliable experimental variogram from sufficient data and the fitting of suitable mathematical models. These are the most important stages of a geostatistical analysis. If they are done with proper care kriging provides the best possible predictions from data.

Chapter 1 introduces the background to geostatistics with examples of the breadth of current applications. Almost all statistical analyses of environmental data, including geostatistics, depend on sample data, and in this chapter we introduce the basic concepts of sampling: the specification of variables, the support and suitable sampling designs. Chapter 2 describes random variables and regionalized variable theory briefly; this is the theory that underpins geostatistics. For readers who wish to know more of the theory we recommend further reading. Chapter 3 explains how to compute the experimental variogram from regular and irregular sampling designs, the factors that affect the reliability of the variogram and how to model the experimental values reliably. Most users of geostatistics are eager to obtain maps of the variables that interest them, and Chap. 4 illustrates how to do this optimally with kriging. The theory of ordinary kriging is described, and we show how the choice of model for the variogram affects the kriging weights. The way the weights are obtained in kriging makes the method different from other interpolators. In Chap. 5 we return to sampling to meet the needs of spatial analysis. We consider the situation where nothing is known about the scale or pattern of spatial variation and for which a nested survey and analysis provide a solution. We suggest other ways of determining the spatial scale to sample for mapping that use variograms from existing data, either of the variables of interest or of intensive ancillary data, such as those from satellites or aerial photographs. Finally, in Chap. 6 we explore the difficulties that spatial trend poses for geostatistical analysis and how they can be overcome by residual maximum likelihood estimation of the variogram and universal kriging.

Springer

http://www.springer.com/978-3-319-15864-8

Basic Steps in Geostatistics: The Variogram and Kriging
Oliver, M.A.; Webster, R.
2015, X, 100 p. 39 illus., Softcover
ISBN: 978-3-319-15864-8