



FIMI-MPGI

**Geostatistical Training & Consulting -
Commercial Policy Jan 2009**

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Consultants Fees

(applied hourly based on 8hr per day)

Senior/Specialised Consultant US\$1000 per day

Course Synopsis (US \$20000) 4 Weeks (Monday to Friday)

This course in particular will create interest to those who are producing advanced surface map, creating contouring map and analysing trend and its interpretation to make an informed spatial decision. This workshop will focus on Geostatistics as it produces better surface map by taking an account of spatial dependence than others interpolation techniques. Geostatistics tools can be applied to any data with Georeferenced spatial information that includes a geographic reference to a particular location on the earth's surface. An increasingly important task in the natural resources is to create spatially continuous models or maps from field data. Spatial models are essential to using such data in Geographic Information Systems. A wide range of statistical and geostatistical techniques are available to conduct mapping in an efficient, quantitative, and scientifically objective manner. This course is designed for scientists dealing with analysis, description and modelling of geographical referenced data or spatial data in short. The practical applications of Geostatistical Analyst software tools, underlying theory, and the correct application of these tools will be emphasized. The course is concluded with an introduction to geographical information systems (GIS) and how these systems may be used in geostatistics. Prerequisites for the course are not required. The course covers eight full days (see below). The course regarding the geostatistics is divided into three parts, which consist of two consecutive full days with a mixture of lectures, theoretically and computer laboratory exercises. See schedule below. The following workshops are aimed at professionals involved in the analysis of spatial data sets for environmental sciences, soil sciences, air pollution, ecology, natural resources and forestry.

Environmental Geostatistics provides a set of statistical tools combined with spatial and temporal structures in data processing. This technical course will introduce the main geostatistical tools for modelling spatial variability, and geostatistical interpolation of any spatial at locations where no measurements were taken. Various geostatistical techniques will be introduced to incorporate secondary information (soil map, digital elevation model, correlated heavy metals) in the prediction of spatial variables at locations where no measurements were taken. Main application of

geostatistics is the assessment of contamination or soil quality which usually takes the form of a map of the probability to exceed critical values, such as regulatory thresholds in soil pollution or criteria for soil quality. Various examples provided by participants will be considered during the workshop.

The objective of this course is to equip all professionals with emerging geostatistics skills for immediate application to problem solving in industry and scientific fields. Since its development in the mining industry, geostatistics has emerged as the primary tool for spatial data analysis in variety of spatial fields, ranging from earth and atmospheric sciences, to agriculture, soil science and environmental studies. This course allows the participant to analyse his/her own data set during the hands-on computer case study session.

OBJECTIVE

To present the basic concepts and methods of geostatistics. To provide an in-depth review of the different simulation methods applicable to the environment. The course specifically addresses issues of uncertainty assessment in different application fields such as soil and water pollutants, soil science, hydrogeology, oceanography, fisheries and civil engineering.

WHO SHOULD ATTEND

The course is designed for practitioners confronted to the study of polluted sites and who wish a practical introduction to geostatistical methods. No prior knowledge of geostatistics is required.

Academics, Agricultural Engineers, Decision-makers, Climatologists, Environmental Consultants, Environmental Engineers, Environmental Epidemiologists, Mining Engineers, Geologist, Reservoir Engineers, Environmental Regulators, Environmental Scientists, Foresters, Geotechnical Engineers, Geophysicists, Soil Scientists, Scientists Geotechnical Engineering, GIS analyst, Surveyors, Biologists, Agriculturalists, Civil engineers, Hydrologists, Statisticians, or any other professionals dealing with the spatial estimation or interpolation.



Week 1

Data Collection - Spatial Modelling Overview of Spatial Estimation

- What is Geostatistics?, Review of Statistical Concepts, Introduction of Non-geostatistical analysis, spatial data analysis, summarization, mapping, representing spatial data, continuous vs. categorical data, histograms and probability, Univariate, bivariate and multivariate analysis, Gaussian distribution and central limit theorem, distributions, cross-correlation in multivariate data, data transformations (logarithmic, indicator), Data import and visualization,

GSLIB software introduction and applications, detection of spatial outliers, Data import and formatting, Notation and Theory of regionalized variables, Case study and hands on practical experience using your own data or provided by FIMI-MPGI. The software GSLIB to be used whenever necessary.

- Case Study Using ISATIS

Week 2

Spatial correlation, variogram, cross variogram

SPATIAL CORRELATION:

- Spatial correlation and associated statistical measures, calculation of experimental variograms and cross variogram, Theoretical Variogram models (mathematical models), omnidirectional variogram, geometric and zonal anisotropy, rose diagram nested variogram structures, indicator variograms, cross-correlation (spatial co-variability of multiple variables). Standardized

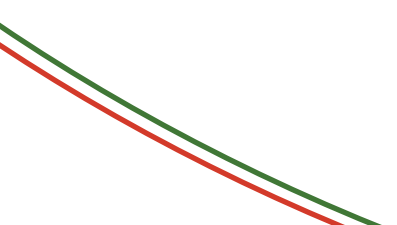
variograms, Deterministic versus probabilistic modeling, pure nugget variogram, nugget, sill and range of influence, variogram behaviour near origin, irregular and regular data- variogram search envelope, kriging weight, The software GSLIB to be used when necessary,

- Case Study Using ISATIS

Week 3

Spatial Estimation Kriging, Co-kriging

- Spatial Estimation (Kriging): Techniques for spatial estimation, 'best' linear unbiased estimation, the kriging system of equations, use and misuse of kriging variance, sensitivity of kriging estimation to variogram structure, kriging strategy, cross-validation of spatial data, co-kriging. Indicator kriging, The software GSLIB to be used when necessary, Multivariate geostatistics and cokriging. Incorporating the correlation between several variables improves the final estimate.
- Using non-stationary geostatistics to respect the trend present in the data.

- Integrating multidisciplinary data: incorporating remote sensing data, co-factors to produce a more realistic image. Multivariate geostatistics and cokriging. Incorporating the correlation between several variables improves the final estimate.
 - Using non-stationary geostatistics to respect the trend present in the data.
 - The limitations of kriging and the introduction to risk analysis: calculation of the probability of overcome a pollution threshold.
 - Case Study Using ISATIS
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Week 4

Change of Support, Stochastic Simulation

- Overview of Support effect & dispersion
- Variance/Volume-Variance Relationship (Affine Correction)/Estimation
- Variance & error/how to change smaller mining units from larger mining units vice versa,
- Dispersion variance & change of support.
- Why we need simulations: sensitivity of the observed statistics to the sampling, limitations of the use of the kriging, risk quantification.
- General overview of simulation methods for both continuous and categorical variables.
- Interpreting the results: histograms, quantile plots and isoprobability maps.
- Simulation vs. kriging, differences, philosophy, applications, adaptation of the kriging system of equations to simulation, theory and application of basic gaussian and indicator simulation algorithms.
- Conditional simulation to generate images, Sequential Gaussian Simulation (SIS),
- The software GSLIB to be used when necessary plus Case Study Using ISATIS
- Resources: Hardcopy and electronic copy of lectures notes, technical paper, journal articles

BENEFITS:

- How to apply geostatistics application for creating surface map using fitted variogram model.
- Identification and modeling of spatial variability, spatial interpolation and stochastic modeling of environmental attributes, creation of risk maps and their use in regulatory authority and decision-making.
- Understand probability plots and any drift
- Understand and apply all statistical parameters
- Understand and apply the Lognormal probability distribution and its parameters
- Understand and apply the principles of variogram and basic inverse distance methods.
- Understand the principles and practical application of experimental variograms along with variogram models.
- Understand an application of ordinary kriging and kriging variance.
- Understand implications of estimation error and confidence limits.
- Understand the principles and practical application of kriging techniques to volume – variance effect model.

COURSE LEADER:

Mr Suresh Tripathi is the CEO of Federation of Indian Mineral Industries - Mining and Petroleum Geostatistics India (MPGI) division based in New Delhi, India. He is an expert and professional senior geostatistician with more than 15 years of working experience in the field of statistics, geostatistics, geographic information system (GIS), conditional simulation, risk assessment & evaluation and reserve estimation in various industries.

He holds double master degrees in Statistics from BHU (India) and Geostatistics from ECU, Australia. After completing his master degrees in the area of geostatistics, he started his geostatistics career at Geoval Australia (Australia's Geostatistical Expert) as a trainee where he learnt geostatistical application to mining data using ISATIS software. After trainee he has worked as a consultant geostatistician for Delta Gold Lt (Australia) in the year 1998 based in Perth, Australia. In the last fifteen years, he has seen an emergence of a wealth of new geostatistical, conditional simulation and probabilistic methods (stochastic methods) applied to various sectors. Most of the courses taught can be also customized according to client requirement.

- Delta Gold Ltd, Western Australia
- Vulcan, Perth Australia
- Gemcom Perth Australia
- Department of Primary Industries, Bendigo, VIC, Australia
- Global Mining Services, Perth Australia
- Datamine International New Delhi India
- Federation of Indian Mineral Industries New Delhi India
- Indian Institute of coal management, Ranchi, India
- Associated Cement Ltd, Mumbai, India
- Hindustan Zinc Limited, India
- Rajasthan State Mines & Minerals Ltd, India.
- Hindustan Copper Limited, India
- Country Fire Authority, Melbourne Australia