CONCEPT

# Geostatistics and Kriging: Variogram Modelling, Spatial Estimation and Simulation

28 June – 2 July 2027
Dubai - Five-star CBD venue



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## Introduction:

Geostatistics and kriging decisions often go wrong when clustered drill or sample data are averaged naively, variograms are fitted by eye and a single smoothed map is treated as certain. Grade tonnage, porosity volumes and contamination footprints are then misstated. This Core Concept course trains geoscientists to explore and decluster spatial data, model experimental variograms with anisotropy and nested structures, run ordinary and universal kriging, validate estimates and generate stochastic realisations in open-source scripting tools. Each participant builds a Geostatistical Estimation and Simulation Study on a case dataset.

## Course Objectives:

- Explore, clean and decluster irregularly sampled spatial data and test stationarity and trend before any estimation
- Calculate experimental variograms and fit licit models with nugget, sill, range, anisotropy and nested structures
- Estimate values and kriging variance at points and blocks with simple, ordinary and universal kriging and select search neighbourhoods
- Validate estimates with cross-validation statistics and swath plots and recognise when indicator kriging or cokriging is warranted
- Generate sequential Gaussian and sequential indicator simulation realisations and summarise uncertainty as probability and quantile maps
- Apply change of support and block estimation to resource, reservoir property and contamination volume questions and report the results

## Target Audience:

- Exploration and mine geologists who interpret drill hole assays and prepare grade models for resource estimation
- Resource geologists who build block models and classify estimates by confidence
- Reservoir geomodellers who populate porosity and permeability grids from well data
- Environmental and soil scientists who map contaminant or soil property concentrations from field samples
- GIS and spatial data analysts who produce interpolated surfaces and need a defensible alternative to inverse distance weighting

## Course Outline:

### Day 1: Spatial Data Exploration, Declustering and Stationarity

- Regionalised Variable Theory and the Random Function Model
- Exploratory Statistics: Histograms, Probability Plots and Outlier Capping
- Cell and Polygonal Declustering Weights for Clustered Sampling
- Stationarity Decisions: Domaining, Trend Surfaces and Residuals
- Scripting Environment Setup in R gstat and Python Geostatistics Libraries

### Day 2: Experimental Variograms and Variogram Modelling

- Semivariogram Calculation: Lag Spacing, Tolerance and Pair Counts
- Nugget, Sill and Range Interpretation With Spherical, Exponential and Gaussian Models
- Geometric and Zonal Anisotropy From Directional Variogram Maps
- Nested Structure Fitting and Licit Model Checks
- Normal Score Transform and Back-Transform for Skewed Grades

### Day 3: Kriging Estimation and Cross-Validation

- Simple Versus Ordinary Kriging Systems and Unbiasedness Constraint
- Universal Kriging With Polynomial Drift for Trending Variables
- Search Neighbourhood Design: Octants, Minimum Samples and Kriging Efficiency
- Leave-One-Out Cross-Validation Statistics and Swath Plot Checks
- Kriging Variance Maps and the Smoothing Effect on Estimated Grades

### Day 4: Indicator Methods, Cokriging, Support Change and Simulation

- Indicator Kriging Thresholds and Order Relation Corrections
- Cokriging and Collocated Cokriging With Secondary Seismic or Geophysical Data
- Point to Block Support: Dispersion Variance and Block Kriging Discretisation
- Sequential Gaussian Simulation Workflow and Realisation Validation
- Sequential Indicator Simulation for Categorical Facies and Lithology

### Day 5: Modelling Build: Geostatistical Estimation and Simulation Study

- Mineral Resource Case: Grade Tonnage Curves From Block Kriging
- Reservoir Property Case: Porosity Realisations and Pore Volume Distribution
- Contamination Case: Exceedance Probability Maps for Remediation Zoning
- Uncertainty Reporting: E-Type Means, Conditional Variance and P10 P50 P90 Maps
- Geostatistical Estimation and Simulation Study Presentation and Peer Review

## Skills You Will Gain:

- Spatial Declustering
- Variogram Modelling
- Kriging Estimation
- Estimate Validation
- Stochastic Spatial Simulation
- Block Model Estimation
- Spatial Uncertainty Quantification
- Geostatistical Scripting

## Why Attend This Course:

- Return with a Geostatistical Estimation and Simulation Study covering variograms, kriged estimates and simulated realisations on a case dataset
- Explain to reviewers why each variogram parameter and search setting was chosen and how it affects the estimate
- Replace single smoothed maps with probability and quantile maps that show where decisions carry the most risk
- Compare estimation practice with mining, petroleum and environmental specialists working on different data types

## Conclusion:

Spatial estimates are only as reliable as the data preparation, variogram model and validation behind them. The week moves from exploratory statistics, declustering and stationarity to experimental variograms, anisotropy and nested models, then to simple, ordinary and universal kriging with cross-validation, and on to indicator methods, cokriging, block support and sequential simulation. The final day applies the workflow to mineral, reservoir and contamination cases and closes with each participant presenting a Geostatistical Estimation and Simulation Study.