N216: Geostatistics and Advanced Property Modelling in Petrel

Instructor(s): Ashley Francis

Format and Duration
Classroom - 4 Days

Summary

The course gives an essential grounding in geostatistical theory, including stochastic theory, variogram analysis and stationarity. Practical use of geostatistics is examined in the context of Kriging (mapping) and stochastic simulation using a volumetric estimation example. More advanced topics include problems associated with change of scale of measurements (support) and multivariate geostatistics including co-kriging, collocated methods and Markov-Bayes.

Learning Outcomes

Participants will learn to:

1. Appraise the role of geostatistical methods in 3D geomodelling and reservoir characterisation.
2. Rate the geostatistical approach against more classical deterministic methodologies.
3. Evaluate the importance concepts of stochastic theory, variogram analysis and stationarity to geostatistical thinking.
4. Assess univariate and multivariate (co-kriging, collocation, entropy and Markov-Bayes) statistical methods and their most effective implementation.
5. Propose appropriate geostatistical data quality control and analysis strategies.
6. Construct variograms as spatial analysis tools for geoscience data mapping.
7. Perform univariate kriging for reservoir extrapolation within the Petrel Advanced Property Modelling package.
8. Compare the range of pixel-based facies simulation options available (SIS, SGS, TGS etc) within Petrel's geomodelling tool-kit.
9. Formulate a multivariate co-kriging strategy within Petrel to provide a most-likely reservoir model estimate.
10. Evaluate reservoir heterogeneity and define upscaling criteria that capture its role within the 3D geomodelling framework.
11. Execute the geological and petrophysical steps within the Petrel Advanced Property Modelling workflow to construct a static 3D reservoir geo-model ready for use in dynamic simulation.
12. Judge the Petrel Advanced Property Modelling module's strengths and pitfalls.

Training Method

A classroom course comprising of a mix of teaching and hands-on exercises using Petrel. The proportion of lecture and computer modelling time is approximately 60/40.

Who Should Attend

The course should be attended by anyone requiring knowledge of how geostatistics can play a role in geoscience mapping. The course will be of particular benefit to those conducting geomodelling and advanced property modelling within Petrel. Seismic mapping considerations will also be considered, in the form of inversion constraints. The course should, therefore, be of interest to a wide range of experienced geoscientists: geological modellers, petrophysicists, and seismic interpreters.

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advanced topics include problems associated with change of scale of measurements (support) and multivariate geostatistics including co-kriging, collocated methods and Markov-Bayes.

The theoretical work is complemented by a thorough examination of advanced property modelling in Petrel. The practical sessions in the course are hands on in Petrel and utilise a small 3D seismic and well log data set. The property modelling exercises cover the scale-up from logs to cells, data analysis, facies modelling, variogram modelling, facies simulation (including a comparison of SIS indicator and object methods) and petrophysical modelling, including porosity estimation and permeability transforms. The final theoretical and practical topic looks at the limitations and practicalities of constraining the reservoir model and its properties using seismic inversion outputs.

At all times, the course emphasises the Petrel workflow and attempts to highlight potential problems, pitfalls and their workarounds.

Theory

1. Statistics
2. Stochastic Theory
3. Stationarity
4. Estimation and Kriging
5. Stochastic Simulation
6. Deterministic, Stochastic and Best Estimate
7. Support
8. Entropy and Bayes' Theorem
9. Cokriging

Advanced Property Modelling

10. Introduction and Framework
11. Stratton Field Introduction
12. Scale Up of Well Logs
13. Data Analysis
14. Facies Modelling
15. Variograms in Petrel
16. Stratton Field Facies Variogram Modelling
17. Seismic Variograms
18. Facies Simulation
19. Petrophysical Modelling
20. Seismic Inversion Constraints