TETRA TECH RPS ENERGY | TRAINING

N506: Reservoir Characterization and Geostatistical Modeling in Field Development

Instructor(s): Jeffrey Yarus

Format and Duration
Classroom - 5 Days

Summary

This course delivers expertise in the applied geostatistical methods that are an essential underpinning of effective modern reservoir characterization and modeling. Variograms, kriging, and stochastic simulation are thoroughly explained from their basics upwards and illustrated in their application to modeling problems. The appropriate use of these methods can not only create a better understanding of the subsurface, but also improve production and drive down the cost per barrel of oil equivalent.

Learning Outcomes

Participants will learn to:

1. Assess modern quantitative reservoir characterization and modeling techniques.
2. Design data quality control and analysis strategies for classical univariate and bivariate statistical methods.
3. Appraise the similarities and differences between traditional statistical methods and geostatistical methods.
4. Construct variograms and formulate their use in spatial analysis and "mapping" of geosciences data.
5. Formulate strategies to provide more spatially rigorous reservoir models, using geostatistical interpolation and stochastic simulation methods.
6. Illustrate the use of kriging and collocated co-kriging to provide the most-likely reservoir model.
7. Characterize commonly used stochastic simulation methods, illustrate their use, and highlight their pros and cons for capturing heterogeneity and assessing uncertainty.
8. Assemble the essential elements of a static 3D reservoir model from structural framework through to petrophysical integration, ready for use in dynamic simulation.
9. Discuss the differences between uncertainty assessment, sensitivity analysis, and risk analysis in reservoir characterization.
10. Evaluate reservoir heterogeneity and discuss upscaling criteria to capture the scale of critical resolution that addresses stated objectives.
11. Formulate reservoir model ranking criteria and evaluate their importance within an overall development plan.

Training Method

A five-day classroom course. Computer exercises constitute about 25% of the class time.

Who Should Attend

The course is primarily aimed at geologists and geophysicists working in field development. It is also applicable to computational scientists and data scientists interested in knowing more about petroleum reservoir modeling in order to improve data analytical and machine learning methods. Prior experience

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with reservoir modeling is helpful, but not required.

Course Content

Reservoir characterization technology has changed dramatically over the last two decades. Reservoir modeling software now has a wide range of powerful statistical and geostatistical functionality and has spread rapidly through the industry as PCs have become faster and user interfaces have simplified the application of complex methods. Further, data analytics and geostatistics is becoming increasing available through popular public computing platforms such as R and Python. However, the understanding required to make optimum use of this functionality has not kept pace and users continue to struggle with understanding many fundamental principles. Hence, a number of misunderstandings and poor workflows have become commonplace. This course addresses these misunderstandings and poor workflows in order to improve your effectiveness in reservoir modeling. Classroom exercises utilize R and R Studio, but the learnings are also applicable to all other software platforms both public and commercial.

- Introduction
  - What is reservoir characterization?
  - What is geostatistics?
  - Reservoir characterization today
  - The basic workflow
- Overview of Classic Statistical Principles
  - Exploratory data analytics and project design
  - Statistical measures
  - R: Workshop 1 & 2: Exploratory Data Analytics
- Spatial Analysis and Modeling
  - Variography, variograms and modelin
  - R: Workshop 3: Spatial Modeling
- Geostatistical Estimation
  - Principles of Kriging and Cokriging
  - Kriging workflows
  - R Workshop 4: Kriging
- Principles of Conditional Simulation and Cosimulation
  - Estimation versus simulation
  - Stochastic simulation
  - Pixel versus object methods
  - Common facies simulation algorithms
  - Common continuous property algorithms
  - Multivariate conditional simulation
- Uncertainty Analysis and Risk
  - The space of uncertainty
  - Orders of uncertainty

- - Visualizing uncertainty
  - Using uncertainty assessment to build business cases
    - Increasing production
    - Decreasing the price per BOE
- Pulling it together: Building the 3D Model
  - General workflow
  - Size and resolution of the model
  - Conceptual geological modeling: structural and stratigraphic framewor
  - Demonstration: Exploring the Earth Model and Post Processing
  - R Workshop 5: Conditional Simulation and Post-processing
- Overview of Ranking and Upscaling
  - Cells; regular, irregular, unstructured
  - Common upscaling methods
  - Common upscaling problems
  - Excel: Workshop 6: Upscaling Exercise