N557: Geostatistics and Data Science; a Practical Introduction to Quantitative Spatial Modeling

Instructor(s): Jeffrey Yarus

Format and Duration

Classroom - 2 Days
Virtual - 4 Sessions

Summary

Geoscientists are struggling to keep pace with rapidly evolving computational environments and the need to integrate modern data science approaches to improve geostatistical modeling of petroleum reservoirs. Sophisticated software for conventional petroleum reservoir modeling has successfully provided tools and workflows for almost 40 years overcoming a broad range of barriers due to reservoir structural complexity and heterogeneity. Successful modeling of unconventional reservoirs is not as well understood, providing new technical challenges to define reservoir sweet-spots, well placement, completion strategies, and production development. Both conventional and unconventional reservoir modeling are undergoing substantial changes due to rapidly changing computational environments to accommodate "big data," high performance computing, distributed computing, and the application and integration of data science. The necessity for petroleum geoscience and engineering professionals to understand the changes that are taking place and develop collaboration skills with computer scientists, developers, and data scientists is critical in order to ensure their professional sustainability.

Business Impact: This course is designed to show geoscience domain specialists how to **improve cost efficiencies**, and both **technical and economic success** through a **better understanding of geostatistical methods, practical data science, and the rapidly evolving computer informatic systems.**

Learning Outcomes

Participants will learn to:

1. Describe and identify basic practical uses of geostatistical principles.
2. Communicate basic modeling informatic needs and objectives to computer specialists (model size, platform, memory, scalability, etc.)
3. Communicate data analytics objectives for model building to data scientists (treatment of missing values, sparse data, univariate and bivariate statistics).
4. Properly install R, Rmarkdown, and necessary code packages.
5. Import data from Excel (or other) and build a Data Frame.
6. Recognize, describe, and navigate the Integrated Development Environment (IDE) for RMarkdown.
7. Run existing RMarkdown code and make simple modifications.
8. Identify the important univariate and bivariate statistical metrics from input data for use in preparing and building static reservoir models.
9. Describe the basic requirements for building geostatistical models.
10. Modify RGeostats scripts to construct omnidirectional and directional experimental semivariograms and fit them with authorized variogram models.
11. Modify RGeostats to construct kriging and conditionally simulated maps.
12. Modify RMarkdown code to run Machine Learning and other data science methods to enhance static petroleum reservoir models.

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Training Method

This is a classroom or virtual classroom course comprising a mixture of lectures, discussion, case studies, and hands-on exercises to be completed by participants during and between sessions.

Who Should Attend

This course is intended for geoscientists and engineers who are interested in learning the basic fundamentals of geostatistical reservoir modeling in the context of data science. Participants will be introduced to a variety of statistical geostatistical methods for building statical reservoir models using continuous interface (CI) languages like R and Python.

Course Content

Topic 1

1. Introduction
    1. What is geostatistics?
    2. What are informatic systems?
    3. What is data science?
2. Introduction to Data Science
    1. Data Science Principles - How is it different from geostatistics and why do we need it?
    2. Data Science Platforms - R and Python
    3. Scalability and informatic systems

Topic 2

1. Introduction to Data Science (Cont)
    1. R and RStudio practicum
        1. Setting up R and RStudio
2. Practical Data Science and Geostatistical Reservoir Modeling
    1. Exploratory data analytics
    2. Data analytics practica:
        1. data tables and data frames
        2. univariate and bi-variate analytics

Topic 3

1. Basic Spatial Modeling
    1. Experimental Semivariograms
    2. Variogram Practicum:
        1. constructing the experimental semivariogram
    3. variogram modeling practicum:
        1. modeling the experimental semivariogram

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Topic 4

1. Basic Kriging and Conditional Simulation
    1. Kriging and Conditional Simulation
    2. Kriging and Conditional Simulation Practica
        1. Interpolation with Kriging
        2. Uncertainty modeling and Conditional Simulation
2. Integrated multivariate analytics and geostatistics
    1. Data Science, Kriging and Conditional Simulation practicum:
3. Closing discussion and comments