Petroleum Data Analytics

Luigi Saputelli, SPE, Senior Reservoir Engineering Adviser, ADNOC, and Frontender Corporation

One of the many challenges we face today in the petroleum industry is the management of data and information. In some instances, we are overwhelmed by the amount and diversity of formats, and, in other cases, we are blinded from the right information to understand a process (What has happened?), to predict the immediate future (What could happen?), or to make proper decisions (What should we do?). The answer to these questions is data analytics supporting appropriate engineering and management judgment and the modeling of actual energy scenarios. Data analytics for strategic decision making is being constantly developed to mitigate low-oil-price scenarios.

For many decades, our technical and business processes have benefited from the wide use of data statistics for decision making. In many instances, predicting and prescribing have relied more on data evidences and trends than on first-principle simulation models. The advancement of computational power, sensor availability, and engineering models has promoted the exponential growth of data types and volumes. Data-driven techniques also have diversified and improved to address such incremental complexities. We are now referring to the professionals who manage and find value from data as "data scientists," and we are calling the management of large and complex data volumes "big data."

Data analytics, either big or small, is the collection of tools that leverages data collection, aggregation, processing, and analysis for describing insights into the past, predicting future performance, and prescribing actions from the optimization of possible outcomes. Current trends of data analytics differ from traditional statistics in the sense that the new data-driven predictive and prescriptive models go beyond data averaging, outlier detection, correlations, and multiple-parameter regression fitting.

Data-analytics tools may include one or more of the following groups: statistics (regression, time series, and factor analysis); pattern recognition (Markov models, principal components, ensemble averaging, classification, and regression); business intelligence (key-performance-indicator dashboards, multidimensional visualization); artificial intelligence for planning, creativity, perception, and social intelligence (knowledge representation, neural networks, support vector machines, Bayesian inference, decision tree, natural-language programming); machine learning (inductive logic programming, rule learning, and clustering); and management of large data sets, distributed and parallel computing, cloud computing services, and data cleansing and profiling.

A graduate degree may be required to master some of the techniques around data analytics, and decades may be required to adopt them across the industry, but it is also true that many of these techniques are evolving at such a fast pace that they become obsolete by the time we plan to roll out a trial pilot. We need to learn how to experiment with, implement, and capture results from data analytics faster than ever. We either evolve quickly or disappear. **JPT**

Luigi Saputelli, SPE, is a senior reservoir-engineering adviser with ADNOC. During the past 25 years, he has held various positions as reservoir engineer, drilling engineer, and production engineer. Saputelli previously worked for 3 years with Hess Corporation, for 5 years with Halliburton, and for 11 years with Petróleos de Venezuela. He is a founding member of the SPE Petroleum Data-Driven Analytics technical section and recipient of the 2015 SPE International Production and Operations Award. Saputelli has authored or coauthored more than 70 technical publications in the areas of digital oil field, reservoir management, reservoir engineering, real-time optimization, and production operations. He holds a BS degree in electronic engineering from Universidad Simon Bolívar, an MS degree in petroleum engineering from Imperial College London, and a PhD degree in chemical engineering from the University of Houston. Saputelli serves on the *JPT* Editorial Committee, the SPE Production and Operations Advisory Committee, and the Reservoir Description and Dynamics Digital Oil Field subcommittee. He has served as reviewer for *SPE Journal* and *SPE Reservoir Evaluation & Engineering* and as an associate editor for *SPE Economics & Management.* Saputelli also serves as managing partner at Frontender, a petroleum engineering services firm based in Houston. He can be reached at lsaputelli@frontender.com.

Recommended additional reading at OnePetro: www.onepetro.org.

SPE 176791 **Use of Regression and Bootstrapping in Drilling Inference and Prediction** *by Chiranth M. Hegde, The University of Texas at Austin, et al.*

SPE 174985 **Topological Data Analysis To Solve Big-Data Problem in Reservoir Engineering: Application to Inverted 4D-Seismic Data** *by Abdulhamed Alfaleh, Saudi Aramco, et al.*

SPE 179958 **Detecting and Removing Outliers in Production Data To Enhance Production Forecasting** *by Nitinkumar L. Chaudhary, University of Houston, et al.*