Integrated Geostatistical Approach for Trend Modeling of Log Property Derivatives in the Permian Basin

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Abstract

Unconventional plays often have tens of thousands of wells where subsurface characterization studies can benefit from an improved and integrated approach that combines data-driven spatial, trend modeling and multivariate analysis in the presence of missing data. Subsurface property trend modeling for continuous unconventional resources imposes additional challenges due to increased well measurement uncertainty and weakened reservoir property to seismic correlation. As a result, we cannot employ the established trend modeling workflows established for conventional reservoirs. In this study, we present a case study of systematic geostatistical workflow for trend modeling. We examined six different well logs from vertical wells acquired in the Bone Spring and Wolfcamp formations of the Delaware basin. Geologic trends were modeled using a sparse data convolution with Bayesian optimization within zones where the decision of stationarity is no longer valid. To assess the quality of the trend model, thorough analysis of the variance and errors was performed for both the trend and residual components. Moreover, we introduce a visual representation and a novel metric called overall goodness that assesses the accuracy, precision, and reliability of the estimates of the trend model. The procedure penalizes the trend model for inaccurate predictions, accounts for the accuracy and variance of the estimates, and considers the spatial correlation of data. This integrated set of methodologies enhances the spatial trend modeling approach for unconventional resources, offering improved accuracy of property estimation and the uncertainty model. The proposed workflow offers an automatic trend modeling together with rigorous metrics to efficiently obtain an optimal model to support optimum decision making in field development.