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Integrating the Secondary Data for an Improved Reservoir Characterization

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Abstract

A longstanding problem in geostatistics is the integration of multiple secondary data in the construction of high resolution facies and property models. Data integration requires the multivariate distribution among the secondary data. One way for estimating multivariate pdf is an indirect estimation through combining univariate distributions conditioned to each secondary data. Permanence of ratios, tau-model and lamda-model are examples of the indirect approach (ref PR,lamda,tau). These indirect methods simply approximate multivariate pdf. Challenges of indirect estimation methods include quantifying data redundancy between secondary variables and how to meet marginal conditions. Data redundancy cannot be simply described as correlation coefficient or covariances: it has a multivariate form and may be nonlinear. Several calibration techniques are considered to find the data redundancy weights. Examples demonstrate different integration results depending on the calibrated data redundancy. As an alternative to the probability combination approaches, directly estimating the multivariate probability density between all secondary variables is proposed. A procedure for direct multivariate density estimation is presented with multivariate kernel functions. The (initial) joint distribution between primary and secondary variables is inferred using the well data. Marginality constraints are then imposed on the initial joint distribution to obtain the updated joint distribution. By performing this, data redundancy is directly accounted for and no external redundancy calibration process is required. Besides, one can use highly reliable information of secondary data distribution to update the joint distribution of interest.