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Combining Grey relational analysis and Bayesian model averaging method to derive staged optimal operating rules of reservoir power generation

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Various regression models were applied to derive functional operating rules of reservoir power generation from a deterministic operation model. It was crucial to analyze and evaluate the model uncertainty involved in reservoir operating rules. However, the relationship between the decision variables and the impact factors for regression models is not constant with various inflows and storage during different periods. In this study, the Grey relational analysis method and the Bayesian model averaging method were combined to derive staged optimal operating rules of reservoir power generation. The staged impact factors were selected based on the correlations with the power output under the optimal deterministic trajectory. Three popular regression models, Particle Swarm Optimization-Support Vector Machine (PSO-SVM), Adaptive Neural Fuzzy Inference System (ANFIS) and Multiple Linear Regression Analysis (MLRA) model were used to derive individual operating rules. BMA was applied to determine the final reservoir operating rules by analyzing the uncertainty of selecting individual models with different weights. A case study of Xinanjiang reservoir in China showed that inflow, storage and their constituent impacted factors play various roles in simulating operating rules during different period. BMA performed best among all operating rules. Compared with the conventional rules, the optimal operating rules made better use of the natural inflows, and improved the power generation efficiency.