Autoregressive and moving average models for time series in the unit interval based on the Reflected Unit Burr XII distribution

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Abstract

This paper introduces a new time series model based on the Reflected Unit Burr XII (RUBXII) distribution. The proposed model is an alternative to the Kumaraswamy autoregressive moving average (KARMA) and beta autoregressive moving average (βARMA) models for time series analysis taking values in the standard unit interval. The conditional median of the RUBXII-distributed discrete-time series is described by a dynamic structure that includes autoregressive and moving average terms, a set of regressors, and a link function. We perform the model's parameter estimation using the conditional maximum likelihood method. Closed-form expressions for the score vector and observed information matrix are presented. We propose and discuss techniques of diagnostic and forecasting for the new model. A Monte Carlo simulation study is carried out to evaluate the finite sample performance of the conditional maximum likelihood estimator. Two empirical applications related to renewable energies are presented and discussed. We analyze the monthly average capacity factor of wind power plants in Northeast Brazil and the percentage of the useful volume of a water reservoirs in Southeast Brazil. Studying these variables is very important since renewable energies are connected to sustainable energy generation, contributing for mitigating climate change and ensuring a clean, secure, and sustainable future. The results evidence that the RUBXII-ARMA model is suitable for describing these data dynamics and providing more accurate forecasts for the analyzed response variables than those from competitors' models. Hence, the proposed model may offer valuable assistance in guiding decision-making toward a more sustainable electric industry.
Keywords: Forecasts; dynamical model; rates and proportions; unit regression models.