Copula-based semiparametric analysis for time series data with detection limits

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Abstract: The analysis of time series data with detection limits is challenging due to the high-dimensional integral involved in the likelihood. Existing methods are either computationally demanding or rely on restrictive parametric distributional assumptions. We propose a semiparametric approach, where the temporal dependence is captured by parametric copula while the marginal distribution is estimated nonparametrically. Utilizing the properties of copulas, we develop a new copula-based sequential sampling algorithm, which provides a convenient way to calculate the censored likelihood. Even without full parametric distributional assumptions, the proposed method still allows us to efficiently compute the conditional quantiles of the censored response at a future time point, and thus construct both point and interval predictions. We establish the asymptotic properties of the proposed pseudo maximum likelihood estimator, and demonstrate through simulation and the analysis of a water quality data that the proposed method is more flexible and leads to more accurate predictions than Gaussian-based methods for non-normal data.