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A bagging approach with a scaled logit transformation for improving predictive performance in non-stationary time series analysis

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Summary: This study develops a novel methodology based on bagging for analyzing non-stationary time series, which leads to a significant improvement in predictive performance. Non-stationary time series are challenging to analyze and predict due to complex dependence structures and time-varying statistical properties. In addition, traditional block bootstrapping techniques used to preserve the dependence structures of time series have a limitation in that a stationarity assumption is required. To resolve these issues and improve the predictive performance for non-stationary time series, this study proposes a bagging approach based on a bootstrapping algorithm including a scaled logit transformation and the seasonal-trend decomposition using loess. The proposed approach is accomplished through the following two steps: First, the scaled logit transformation without the stress related to parameter estimation is employed to overcome a non-normality problem and stabilize the variance. Then, a moving block bootstrapping technique is applied to a remainder component obtained via the seasonal-trend decomposition using loess. The superiority of the proposed approach is substantiated by analyzing real datasets with non-stationarity and comparing to two established approaches: One is a bagging approach with a Box-Cox transformation, and the other is a traditional time series approach without bootstrapping. The proposed approach effectively handles the complex dependence structures and temporal variations inherent in non-stationary time series, holding the potential for broad application across diverse fields in time series analysis and prediction.

Keywords: bagging, moving block bootstrap, scaled logit transformation, time series analysis

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