Factor-Augmented Modeling and Forecasting: regional animal abundance and dynamics

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Abstract

This paper analyzes and forecasts the regional abundance levels of several ungulates species in Kruger National Park, South Africa, which strengthens and extends the understanding about the local population density and dynamics. We employ a multi-level factor model to investigate regional population changes, in which covariation can be represented by common factors and idiosyncrasy can be captured by regional and/or species-specific factors. Additionally, the factors in various levels can be consistently estimated using principal components. Besides, we construct one-step-ahead forecast of populations and obtain the optimal forecasts using a handful of estimated factors as augmented predictors. Furthermore, we evaluate the forecasting accuracy, and conclude that using multi-level factors can lead to substantial improvement of predictive performance for most species of our interest. However, the extent of improvement differs widely across species and regions.

Keywords: Animal Population Dynamics, Factor-augmented Forecasting, Common Factor, Idiosyncratic Factor, Principal Component, Predictive Performance