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Error Correction Based Deep Neural Networks for Modeling and Predicting South African Wildlife–Vehicle Collision Data

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Seasonal Auto-Regressive Integrated Moving Average with exogenous factors (SARIMAX) has shown promising results in modeling small and sparse observed time-series data by capturing linear features using independent and dependent variables. Long short-term memory (LSTM) is a promising neural network for learning non-linear dependence features from data.

With the increase in wildlife roadkill patterns, SARIMAX-only and LSTM-only would likely fail to learn precisely several endogenous and/or exogenous variables driven by such wildlife roadkill data. In this paper, we design and implement an error correction mathematical framework based on LSTM-only. The framework extracts features from the residual error generated by a SARIMAX-only model.
The learned residual features correct the output time-series prediction of the SARIMAX-only model. The process combines SARIMAX-only predictions and LSTM-only residual predictions to obtain a hybrid SARIMAX-LSTM. The models are evaluated using South African wildlife-vehicle collision datasets, and experiments show that compared to single models, SARIMAX-LSTM increases the accuracy of a taxon whose linear components outweigh the non-linear ones. In addition, the hybrid model fails to outperform LSTM-only whenever a taxon contains non-linear components than linear components. Our assumption of the results is that the collected exogenous and endogenous data are insufficient, which limits the hybrid model's performance since it cannot accurately detect seasonality on residuals from SARIMAX-only and minimize the SARIMAX-LSTM error. We conclude that the error correction framework should be preferred over single models in wildlife time-series modeling and predictions whenever a dataset contains more linear components. Adding more related data may improve the prediction performance of SARIMAX-LSTM.

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