

A NOVEL INAR(1) MODEL WITH TWO LATENT MARKOV PROCESSES FOR REGIME AND DISTRIBUTION PARAMETER CONTROL

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ABSTRACT

The authors propose a new model for count time series based on a hybrid structure that combines an autoregressive component with an innovation-driven component, where regime selection at each time point is governed by a latent Markov process. The key novelty of the model is the introduction of an additional, independent latent process that dynamically modulates the parameters of the marginal distribution within each regime. This dual-latent structure enables a separation between the dynamic behavior of the series and its distributional characteristics, thereby achieving substantially greater flexibility in modeling complex and nonstationary processes. The proposed framework is particularly suitable for data in which both the dependence structure and the distribution evolve over time due to varying environmental regimes. In this way, the model naturally captures structural changes and heterogeneity in the data. Applications to real-world count time series demonstrate that the model effectively captures these dynamics while providing a stable and interpretable representation of the underlying process, making it suitable for a wide range of applications in discrete-time series analysis.

Keywords: random environment, INAR(1) process, modified negative binomial thinning, Markov chains, geometric marginal.