Short Time Scale Autoregressive Process

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Abstract

Autoregressive (AR) models are fundamental tools in time series analysis, capturing temporal dependencies through lagged observations. While traditional approaches often focus on long-term dynamics, many real-world phenomena—such as high-frequency financial data, climate fluctuations, and energy demand—exhibit behaviors that are best understood at shorter time scales and are often influenced by seasonal effects. In this work, we introduce and study the Short Time Scale Autoregressive (STAR) process, designed to model short-range temporal correlations with particular attention to rapidly evolving structures in the data while explicitly incorporating seasonal components. We discuss the mathematical formulation of the STAR process with seasonality, its statistical properties, and conditions for stationarity. Estimation techniques and model selection criteria are presented, supported by illustrative numerical simulations. The proposed framework highlights the importance of considering both short time scales and seasonal dynamics in autoregressive modeling, opening perspectives for theoretical developments and practical applications in fields where fine temporal resolution and recurrent patterns are essential.