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Stability Properties of Certain Markov Chain Models in Random Environments

In time series analysis, considerable efforts have been invested in formulating nonlinear models that align with the concept of stationarity. These models should also allow the application of various limit theorems essential for statistical inference.
Markov chain techniques have been extensively employed to investigate the stability properties of numerous autoregressive processes.
In this presentation, we aim to explore the feasibility of integrating exogenous covariates into such dynamical systems. Despite their practical significance, the incorporation of exogenous covariates into autoregressive processes remains inadequately comprehended.
We will introduce stability criteria applicable to select Markov chain models operating within random environments, offering potential solutions to address these complexities.
Our discussion will encompass two primary approaches. The first pertains to extending a classical drift/small set criterion. Notably, in certain observation-driven models detailed in the literature, the small sets theory proves inapplicable. Subsequently, we will introduce a second criterion designed to circumvent this limitation.
Both cases rely on appropriate coupling methodologies to manage the loss of memory within chain iterations, measured in terms of either total variation or Wasserstein-type distances.
The presentation will feature numerous illustrative examples where this theory can be effectively applied.