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Verifiable Conditions for Irreducibility and Aperiodicity of a Markov Chain through the Deterministic Control Model

We present new conditions which allow to easily prove the irreducibility and aperiodicity of a Markov chain. For a Markov chain (Φ_k) modelled by a function F and an i.i.d. sequence (U_k) such that
$$\Phi_{k+1} = F(\Phi_k, \alpha(\Phi_k, U_{k+1})),$$
under some conditions on F and α, irreducibility and aperiodicity can be proven by analyzing deterministic sequences. This extends previous similar conditions for irreducibility which impose the full function $(x, u) \mapsto F(x, \alpha(x, u))$ to be C^∞. In contrast, we assume F to be C^1, and the function $(x, u) \mapsto F(x, \alpha(x, u))$ can be discontinuous. The conditions are also proven to be necessary and sufficient.

We provide in this presentation the necessary background to express these conditions, and present non-trivial examples in which we prove irreducibility and aperiodicity.