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Revealing a temporal symmetry/asymmetry dichotomy in a Markovian setting, and a parameterization based on fractional low-order joint moments

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We show that "an arrow of time", which is reflected by the joint distributions of successive variables in a stochastic process, may exist (or not) solely on grounds of marginal probability distributions, without affecting stationarity or involving the structural dependencies within the process. The temporal symmetry/asymmetry dichotomy thus revealed, is exemplified for the simplest case of stably-distributed Markovian recursions, where the lack of Gaussianity, even when the increments of the process are independent and identically distributed (i.i.d.) with symmetric marginal, is generating a break of temporal symmetry. We devise a statistical tool to evidence this striking result, based on fractional low-order joint moments, whose existence is guaranteed even for the case of "fat-tailed" strictly-stable distributions, and is thereby suited for parameterizing structural dependencies within such a process.