Predicting time series with abrupt changes and smooth evolutions

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Abstract: A methodology (referred to as kinetic prediction) is introduced for predicting time series undergoing unknown abrupt changes or smooth evolutions in their data generating distributions. Based on Kolmogorov epsilon-entropy, we propose a concept called epsilon-predictability that quantifies the size of a model class and the maximal number of structural changes that guarantee the achievability of asymptotically optimal prediction. Moreover, for parametric distribution families, the aforementioned kinetic prediction with discretized function spaces is extended to its counterpart with continuous function spaces, which naturally leads to an efficient sequential Monte Carlo implementation. Wide applicability of the proposed methodology will be illustrated by its applications to time-varying cointegration, time-varying volatility models, and case studies in finance.