

Time series central subspace

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Abstract: We develop a sufficient dimension reduction theory for time series, which does not require specification of a model but seeks to find a $p \times d$ matrix Φ_d with smallest possible number $d \leq p$ such that the conditional distribution of $x_t | X_{t-1}$ is the same as that of $x_t | \Phi_d^T X_{t-1}$, where $X_{t-1} = (x_{t-1}, \dots, x_{t-p})^T$, resulting in no loss of information about the conditional distribution of the series given its past p values. We define the subspace spanned by the columns of Φ_d as the time series central subspace and estimate it using Kullback-Leibler distance. We show that the estimator is consistent when p and d are known. In addition, we propose a consistent estimate of d and a graphical method to determine the lag p . Finally, we present examples and real data analysis to illustrate the proposed theory, which may open new research avenues in time series data analysis.