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Factor modeling for high-dimensional time series: Inference for the number of factors

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(Submitted on 4 Jun 2012)

This paper deals with the factor modeling for high-dimensional time series based on a dimension-reduction viewpoint. Under stationary settings, the inference is simple in the sense that both the number of factors and the factor loadings are estimated in terms of an eigenanalysis for a nonnegative definite matrix, and is therefore applicable when the dimension of time series is on the order of a few thousands. Asymptotic properties of the proposed method are investigated under two settings: (i) the sample size goes to infinity while the dimension of time series is fixed; and (ii) both the sample size and the dimension of time series go to infinity together. In particular, our estimators for zero-eigenvalues enjoy faster convergence (or slower divergence) rates, hence making the estimation for the number of factors easier. In particular, when the sample size and the dimension of time series go to infinity together, the estimators for the eigenvalues are no longer consistent. However, our estimator for the number of the factors, which is based on the ratios of the estimated eigenvalues, still works fine. Furthermore, this estimation shows the so-called "blessing of dimensionality" property in the sense that the performance of the estimation may improve when the dimension of time series increases. A two-step procedure is investigated when the factors are of different degrees of strength. Numerical illustration with both simulated and real data is also reported.

Comments:	Published in at this http URL the Annals of Statistics (this http URL) by the Institute of Mathematical Statistics (this http URL)
Subjects:	**Statistics Theory (math.ST)**
Journal reference:	Annals of Statistics 2012, Vol. 40, No. 2, 694-726
DOI:	10.1214/12-AOS970
Report number:	IMS-AOS-AOS970
Cite as:	**arXiv:1206.0613 [math.ST]**
	(or **arXiv:1206.0613v1 [math.ST]** for this version)

Submission history