## The Two-Stage Information Criterion to Select an Autoregressive Model: a Unified Approach Without Knowing the Order of Integratedness

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## Abstract

While it is a common practice to do prediction with pre-tests for unit root, it is well-known that the resulting prediction can be very unreliable, should the data are erroneously differenced. This paper proposes the so-called two-stage information criterion (TSIC) to select an I(d) autoregressive (AR) model without knowing the order of integratedness d, where d is a non-negative integer. When the underlying AR process is known to be stationary and of infinite order, Shibata (1980) showed that AIC is asymptotically efficient. On the other hand, Ing (2007) removed the infinite-order assumption and verified several information criteria's asymptotic efficiency in both finite- and infinite-order I(0) AR models. Using the asymptotic expression for the prediction mean squared error (PMSE) of an I(d) model developed in Ing, Sin and Yu (2009), this paper first shows that AIC's asymptotic efficiency in I(0) AR( $\infty$ ) processes carries over to I(d) AR( $\infty$ ) processes, where d = 1, 2 .... Further, we derive the asymptotic efficiency of the TSIC of Ing (2007) in possibly infinite-order AR models of unknown d. The latter result is one of the most general order selection theories in the research field opened up by Shibata (1980). Simulation evidence in support of our theoretical findings, as well as suggestions on the practical details on this two-stage information criterion, are also given.

Keywords: Asymptotic efficiency; Model selection; Order of integratedness; Possibly infinite order; Prediction mean squared error (PMSE); Two-stage information criterion.