On testing high dimensional white noise

Zeng Li

Southern University of Science and Technology
E-mail: liz9@sustech.edu.cn

Abstract: "Testing for white noise is a classical yet important problem in statistics, especially for diagnostic checks in time series modeling and linear regression. For high-dimensional time series in the sense that the dimension p is large in relation to the sample size T, the popular omnibus tests including the multivariate Hosking and Li-McLeod tests are extremely conservative, leading to substantial power loss. To develop more relevant tests for high-dimensional cases, we propose a portmanteau-type test statistic which is the sum of squared singular values of the rst q lagged sample autocovariance matrices. It, therefore, encapsulates all the serial correlations (upto the time lag q) within and across all component series. Using the tools from random matrix theory and assuming both p and T diverge to innity, we derive the asymptotic normality of the test statistic under both the null and a specic VMA(1) alternative hypothesis. As the actual implementation of the test requires the knowledge of three characteristic constants of the population cross-sectional covariance matrix and the value of the fourth moment of the standardized innovations, non trivial estimations are proposed for these parameters and their integration leads to a practically usable test. Extensive simulation conrms the excellent nite-sample performance of the new test with accurate size and satisfactory power for a large range of nite (p; T) combinations, therefore ensuring wide applicability in practice. In particular, the new tests are consistently superior to the traditional Hosking and Li-McLeod tests."