

# Testing for Series Correlation and ARCH Effect of High-Dimensional Time Series Data

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## Abstract

This paper proposes two portmanteau tests for series correlation and ARCH effect of high-dimensional data, which allows the dimension of data  $p=p(n)\rightarrow\infty$  when the sample size  $n\rightarrow\infty$ . We first show that the sample autocorrelation function of the  $L_1$ -norm of data is asymptotically normal and a norm-based portmanteau test statistic is asymptotically  $\chi^2$ -distributed. When the cross-sectional variables are  $s$ -dependent (i.e., at most  $s$  elements are dependent), the test still works well in the case with  $p>n$ . Using a suitable function of data, the norm-based test can be applied for the heavy-tailed time series. We next show that the sample autocorrelation function of the Spearman's ranks of the  $L_1$ -norm of data is asymptotically normal and the norm-based rank test statistic is asymptotically  $\chi^2$ -distributed. Surprisingly, the norm-based rank test is dimension-free, i.e. independent of  $p$ , and without any moment condition of data and without the covariance structure condition as required in the literature. Simulation results show that both test statistics have satisfactory sizes and are very powerful even for small  $n$  and large  $p$ .