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

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**Abstract:** This article proposes several tests for detecting serial correlation and ARCH effect in high-dimensional data. The dimension of data $p = p(n)$ may go to infinity when the sample size $n \to \infty$. It is shown that the sample autocorrelations and the sample rank autocorrelations (Spearman's rank correlation) of the L1-norm of data are asymptotically normal. Two portmanteau tests based, respectively, on the norm and its rank are shown to be asymptotically $\chi^2$-distributed, and the corresponding weighted portmanteau tests are shown to be asymptotically distributed as a linear combination of independent $\chi^2$ random variables. These tests are dimension-free, that is, independent of $p$, and the norm rank-based portmanteau test and its weighted counterpart can be used for heavy-tailed time series. We further discuss two standardized norm-based tests. Simulation results show that the proposed test statistics have satisfactory sizes and are powerful even for the case of small $n$ and large $p$. We apply the tests to two real datasets. Supplementary materials for this article are available online.