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TESTING FOR HIGH-DIMENSIONAL WHITE NOISE

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Abstract: Testing multi-dimensional white noise has been an important subject of statistical inference in time series. Such test in the high-dimensional case becomes an open problem waiting to be further investigated, especially when the dimension of a time series is comparable to or even greater than the sample size. To detect an arbitrary form of departure from high-dimensional white noise, a few tests have been developed. Some of these tests are based on max-type statistics, while others are based on sum-type ones. Despite the progress, an urgent issue awaits to be resolved: none of these tests is robust to the sparsity of the serial correlation structure. Motivated by this, we propose a Fisher's combination test by combining the max-type and the sum-type statistics, taking advantage of the established asymptotic independence between them. This combination test can achieve robustness to the sparsity of the serial correlation structure, and combine the advantages of the two types of tests. We thoroughly study the theoretical properties of the proposed combination test, and demonstrate its advantages over some existing tests through extensive numerical results and an empirical analysis.

Key words and phrases: Asymptotic independence, Fisher's combination test, high-dimensional white noise, hypothesis test, robustness.

1. Introduction

Testing for white noise or serial correlation is an important problem in statistical modeling and inference, especially in diagnostic checking for linear regression and linear time series modeling. In recent years, researchers are increasingly interested in modeling high-dimensional time series data, which are becoming one of the most common data types, and frequently appear in many applications, including meteorology, genomics, chemometrics, biological and environmental research, finance and econometrics, etc. This brings further challenge to diagnostic checking, as we need to perform test for high-dimensional white noise, where the dimension of time series is comparable to or even greater than the sample size, i.e., the observed length of the time series.

For univariate time series, many widely used white noise tests have been proposed in the literature (Li, 2004). Some of these tests have been extended for testing multivariate time series (Hosking, 1980; Li and Mcleod, 1981), which

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