Testing high dimensional covariance matrices via posterior Bayes factor. (English)

Summary: With the advent of the era of big data, high dimensional covariance matrices are increasingly encountered and testing covariance structure has become an active area in contemporary statistical inference. Conventional testing methods fail when addressing high dimensional data due to the singularity of the sample covariance matrices. In this paper, we propose a novel test for the prominent identity test and sphericity test based on posterior Bayes factor. For general population model with finite fourth order moment, the limiting null distribution of the test statistic is obtained. Furthermore, we derive the asymptotic power function when the sample size and dimension are proportional against spiked alternatives. When the dimension is much larger than the sample size, under general alternatives, the limiting alternative distribution together with the consistency of the new test is also obtained. Monte Carlo simulation results show that the limiting approximation is quite accurate under the null for finite sample, and the proposed test outperforms some well-known tests in the literature in terms of Type I error rate and the empirical power.

MSC:
62R07 Statistical aspects of big data and data science
62H10 Multivariate distribution of statistics
62H12 Estimation in multivariate analysis
62H15 Hypothesis testing in multivariate analysis
60F05 Central limit and other weak theorems
65C05 Monte Carlo methods

Keywords:
central limit theorem; high-dimensional covariance matrix; identity test; posterior Bayes factor; sphericity test

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References: