Matrix mean testing in models with a special class of variance matrices

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Abstract

In recent years, multivariate models with matrix-valued observations attract more and more attention, see e.g. [1], [2] or [3]. One of the main problems of their practical use is usually the problem of small sample size, which causes numerical instability or even rank deficiency of the sample variance matrix. As a result, mean testing can be problematic or even impossible. Various special variance structures are used, when possible, to tackle the problem. However, this brings the need to derive the distribution of the test statistic for every special variance matrix structure. We will present the solution for a general class of test procedures, when the variance matrix can be decomposed into parts belonging to some commutative quadratic subspace. Three classical test procedures – Likelihood ratio, Rao score and Wald test – are studied. Exact null distribution as well as the distribution under large- and high-dimensional regime are derived. This covers many previous results, which can be viewed as special cases of the general model introduced here.

Keywords

Multivariate linear model, Special variance structure, Quadratic subspace, Mean testing.

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