

Combined permutation invariant covariance matrix and estimation in multilevel models

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The objective of this paper is to combine shift and non-shift invariance in multilevel models. The random factors are described via their covariance matrices and it is shown that the two types of invariance imply two specific structures for the covariance matrices: block circular Toeplitz and block compound symmetry. Useful results are obtained for the spectrum of such permutation invariant covariance matrices and model reparameterization is performed by putting restrictions on the spectrum. Spectral decomposition is exploited to derive explicit maximum likelihood estimators of the variance and covariance components.