Linear models with doubly exchangeable distributed errors

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Abstract

We study the general linear model (GLM) with doubly exchangeable distributed error for m random variables observed repeatedly over time and space. Doubly exchangeable linear models (DEGLMs) are suitable for three-level multivariate data, which is very common in biomedical, medical, engineering and in many other applications. The DEGLM arises when the m-dimensional error vectors are "doubly exchangeable" jointly normally distributed, which is a much weaker assumption than the independent and identically distributed error vectors in case of GLM. We estimate the parameters in the model and also find their distributions. Doubly exchangeable covariance structure assumes a block circulant covariance structure consisting of three unstructured covariance matrices for three multivariate levels. To be more precise, let t and s stand for a given point in time and a given site, respectively. Let $\boldsymbol{x}_{ts} : \Omega \to \Re^m$, $1 \leq t \leq v$, $1 \leq s \leq u$, be the $m-$dimensional normally distributed random vector at the t^{th} time point and at the s^{th} site. Then the random families $(\boldsymbol{x}_{1s})_{s\in\{1,\ldots,u\}}, \ldots, (\boldsymbol{x}_{vs})_{s\in\{1,\ldots,u\}}$ are assumed to be exchangeable. Furthermore, for fixed t, the family of random variables $(\boldsymbol{x}_{ts})_{s\in\{1,\ldots,u\}}$ is exchangeable. That is, doubly exchangeable covariance structure has a blocked constant covariance matrix over time, like the compound symmetric covariance structure has constant variance over time for the univariate repeated measures data or just one-level multivariate data.

Keywords

Linear models, Doubly exchangeable covariance structure.

References

Roy, A. and Leiva, R. (2007). Discrimination with jointly equicorrelated multi-level multivariate data. *Advances in Data Analysis and Classification 1(3)*, 175–199.