

# Multivariate linear models with Kronecker covariance structure

Dietrich von Rosen

*Swedish University of Agricultural Sciences, Uppsala, Sweden*

## Abstract

Models based on  $pq$ -dimensional normally distributed random vectors  $\mathbf{x}$  are studied with a mean  $vec(\mathbf{ABC})$ , where  $\mathbf{A}$  and  $\mathbf{C}$  are known matrices, and a separable covariance matrix  $\mathbf{\Psi} \otimes \mathbf{\Sigma}$ , where both  $\mathbf{\Psi}$  and  $\mathbf{\Sigma}$  are positive definite and except the estimability condition  $\psi_{qq} = 1$ , unknown. The model may among others be applied when spatial-temporal relationships exist. In particular the special case  $\mathbf{A} = \mathbf{I}$  is studied. On the basis of  $n$  independent observations on the random vector  $\mathbf{x}$ , we wish to estimate the parameters of the model. Estimation equations for obtaining maximum likelihood estimators are presented. It is shown that there exist only one solution to these equations. Likelihood equations are also considered when  $\mathbf{FBG} = \mathbf{0}$ , with  $\mathbf{F}$  and  $\mathbf{G}$  known. Moreover, the likelihood ratio test for testing  $\mathbf{FBG} = \mathbf{0}$  against  $\mathbf{FBG} \neq \mathbf{0}$  is considered.