

# 'Confirmatory' ICA

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## Abstract

We shall begin by an example shown in a path diagram in Fig.1. The model is an unusual structural equation model (SEM) in that the specific factors  $s_i$  as well as the latent factor  $f$  explains the dependent variable  $Y$ . The model is not estimable within the framework of the SEM since it is not identifiable. To identify, one needs to give pre-calculated values to one of the path coefficients to  $Y$  and the variances of  $s_i$ .

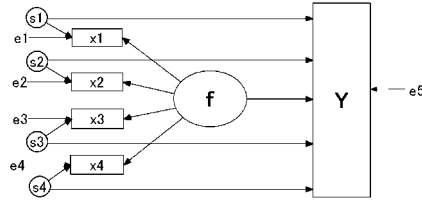


Figure 1: Examination of specific factors

It is noted that the model is expressible in the form:

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ y \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & 0 & 0 & 0 \\ a_{21} & 0 & a_{23} & 0 & 0 \\ a_{31} & 0 & 0 & a_{34} & 0 \\ a_{41} & 0 & 0 & 0 & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{bmatrix} f \\ s_1 \\ s_2 \\ s_3 \\ s_4 \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \\ e_5 \end{bmatrix} = \mathbf{A}\mathbf{s} + \mathbf{e} \quad (1)$$

When one can assume that  $f$  and  $s_1, \dots, s_4$  are independent and nonnormally distributed and that all the errors  $e_i$  are normal, then it is nothing but a noisy ICA model, and it is estimable. The typical ICA model (e.g., Jutten and Herault, 1991) does not assume a particular structure for a mixing matrix  $A$ ; whereas the matrix  $A$  here has a clear structure. Thus, we would say that the typical ICA is of *exploratory* nature and that the model here is of *confirmatory* nature.

In the situation above, we shall present two estimation procedures. One is a two-stage procedure, where one implements a usual ICA to obtain an estimator  $\hat{A}$  without any structure on  $A$  and using the least squares, the structural parameters  $a_{ij}$  are estimated based on the  $\hat{A}$ . The other one is to optimize an objective function (cumulants) in terms of structural parameters. We also discuss evaluation of the model fit (e.g. Shimizu and Kano, 2003), which is an important process in confirmatory analysis.

## References

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