Simple structure estimation via prenet regularization

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In estimation of statistical model, we often use a regularization method, which produces stable estimator and allows model structure estimation. The regularization method is applied to not only regression analysis but also dimensionality reduction, such as the principal component analysis and the factor analysis. For example, in factor analysis model, we use the lasso-type regularization method to obtain interpretable common factors. In this paper, we propose the Prenet (Product elastic net) regularization, which is completely different from the lasso-type regularization. The regularization term is based on the product of a pair of elements in each row of the loading matrix. The prenet enhances the simplicity of the loading matrix, which plays an important role in the interpretation of the common factors. With a large amount of prenet penalization, the estimated loading matrix possesses a perfect simple structure, which is known as a desirable structure in terms of the simplicity of the loading matrix. The perfect simple structure estimation via the prenet regularization turns out to be a generalization of the *k*-means clustering of variables. Real data analyses are given to illustrate the usefulness of our regularization method.

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