A Stabilyzing Algorithm for Longitudinal Data Analysis Networks[1]

Massimo Aria
Dipartimento di Matematica e Statistica
Università degli Studi di Napoli Federico II
aria@unina.it

Abstract
This paper provides an alternative approach for longitudinal data analysis through the use of a set of identified parallel networks.
Longitudinal data can be defined as data resulting from the observation of subjects (human, animals, organization etc.) over time/space. In this field, we propose a *parallel neural network* for the analysis of longitudinal categorical data with constant row-sum, using a learning algorithm based on a simultaneous latent budget model (SLBM) [3]. A SLBM is a reduced-rank probability model to decompose a series of T tables of compositional data observed in different times considering the constraints across the rows or columns defined on the data. The aim of SLBM is to approximate the generic matrix $P_{(t)}$ of observed budgets through K latent budgets obtained as the combination of matrix $A_{(t)}$ of *mixing parameters* and the matrix $B_{(t)}$ of *latent components* satisfying restrictions likewise conditional probabilities. Formally $P_{(t)} \approx \Pi_{(t)} = A_{(t)}B'_{(t)}$ with the linear constraints $A_{(t)}1_K = 1_I$ and $1'_J B_{(t)} = 1_K$ for $t = 1, ..., T$.
A problem, well known in literature, is that the Latent Budget Model is not identifiable. In this case, it means that the learning algorithm produces unidentified solution for the parallel network. In this paper, we extend the algorithm, called *Stabilizing Algorithm* [1], to identify an unique solution for the parallel network parameters. The key idea is to use a method based on the structure of the class of Metropolis algorithm [2] to identify the optimal solution which maximizes the sum of chi-square distances among the latent budgets.
There are several application fields in which the Parallel Neural Network can be applied with good results. In particular, this methodology allows to learn a network that takes into account, simultaneously, the links among the data along the time in all grounds where this matter is crucial.

References

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