

CHAPTER TEN

CONCLUSION AND FURTHER RESEARCH

The problem of greatest interest in this dissertation has been canonical variate analysis with measurements over time. I suggest three approaches: a maximum likelihood approach based on modeling the means (Chapter Eight): a least squares approach based on three-mode principal components (Chapter Five): and an analysis of covariances approach (Chapter Seven). What proves to be a unifying theme in these attempts to model CVA over time, indeed throughout the entire dissertation, is that of the common variate over time (or over a third mode).

The most ambitious of the methods to model CVA over time is the maximum likelihood approach. In addition to modeling the means, I model the error terms over time. I provide a model for error which is constant over time and changes over time. I also work out estimating equations to solve for the parameter estimates and implement an algorithm to obtain the

estimates. Lastly I show that my approach is superior to doubly multivariate repeated measures in conceptualizing the problem of multivariate grouped data over time.

The least squares method I develop as an exploratory approach (Chapter Five). I show it to have attractive features such as the partitioning of the sums of squares and the nestedness of solutions (Chapter Three). I also develop graphical methods to be used in conjunction with it (Chapter Six).

The covariance structure analysis (COSAN, Chapter Seven) approach puts modeling CVA over time in an larger framework of methods that have an extensive usership, a developed theory, and powerful software. Despite this promise, however, more work needs to be done on the programming and on achieving convergence of the estimating algorithm.

In this dissertation I also approach several problems related to CVA over time. In Chapters Five and Six I propose a schema for modeling a broad variety of data with two sets of variables measured over a third mode. This includes modeling canonical correlation analysis (CCA), canonical variate analysis (CVA), redundancy analysis (RA), Procrustes Rotation (PR) and correspondence analysis with both data over time and multiple datasets.

In Chapter Four I develop a least squares approach to common principal components, which I show is comparable to the maximum likelihood method. I also extend the least squares method to common space analysis.

In Chapters Three and Nine I do not develop any new methods, but rather certain supporting ideas. In Chapter Three I show the partitioning of sums of squares and prove the nestedness of solutions for the PARAFAC (orth.) model. In Chapter Nine I extend the ideas for scale invariance previously developed for the analysis of covariance structures to three-mode principal components models.

I have just summarized the many problems tackled in this dissertation. The work done, however, suggests more problems to be solved. In particular, there is still much that can be done to develop and extend the ideas in the dissertation. What follows is a list of some of the possibilities.

- For the CVA/time model of Chapter Eight work out a method for handling missing values. Use Ware's (1985) approach to longitudinal regression which iteratively estimates the error matrix and the means model.
- Prepare a SAS macro for estimating the CVA/time model.
- Investigate the robustness of CVA/time model to heterogeneous variance over groups, outliers and non-normality.
- Develop a SAS macro for the least squares methods for CVA/third, CCA/third, RA/third and PR/third.
- Develop hypothesis tests and confidence intervals for the three-mode models. A possibility may be to use resampling methods.
- Investigate modeling the relationship between two sets of variables over time when one drops the restriction that both sets of variables be orthogonal.
- Develop a SAS macro for COSAN modeling for canonical variate analysis and redundancy analysis over time.

- Extend the COSAN model to include uncorrelated canonical variates over time and unique variates at each occasion.
- Develop hypothesis tests and confidence intervals for COSAN models.
- Investigate the modeling of error structure over time in the COSAN approach to canonical variate analysis over time.
- Compare the maximum likelihood, least squares and COSAN approaches to CVA over time.
- Investigate how good a Tucker2 model must fit in order to have approximate scale invariance.